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## LOUIS CHARLES CHRISTOPHER KRIEGER, 1873-1940

JOHN A. STEVENSON

(WITH PORTRAIT)

A figure unique in the annals of American mycology passed from the scene of his earthly labors July 31, 1940. L. C. C. Krieger was the creator of the finest series of watercolor paintings of the fleshy fungi yet produced in America. The late C. G. Lloyd said of his work "Such perfection of illustration has never been reached by anyone else in this country and in Europe only by Boudier. There may never be another as competent as he." Not only do Krieger's plates approach perfection artistically, but they are technically correct as well to the most minute detail, a rare but much to be desired combination. In his zeal to perfect his mushroom paintings he acquired by long hours of patient study an astonishing knowledge of the larger American fungi, *Boletus* in particular, and of the pertinent literature.

Louis Charles Christopher Krieger was born in Baltimore, Maryland, February 11, 1873, the son of Henry and Katharine Lentner Krieger. His early education was obtained in the public and parochial (Lutheran) schools of his native city. His artistic capabilities were early apparent, and at the precocious age of 13 he was enrolled at the Maryland Institute School of Art and Design. Later his studies were continued at the Charcoal Club School of Fine Arts. His association with the latter institution continued through-

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out most of his life, and, in fact, such was his intimate connection with the Club, that his friends often referred to him as Louis "Charcoal Club" Krieger.

As a youth of 18 Krieger received his first appointment in the Department of Agriculture as an artist assistant, assigned to the Division of Microscopy. This was an interesting organization, the technical staff of which consisted of Dr. Thomas Taylor alone, who, since 1871 had been dabbling in all manner of activities involving the microscope and acting as his own artist.

At this time Dr. Taylor's chief hobby was the mushrooms, and his new staff member was put to work painting those found in and about the District of Columbia, and in copying certain of the plates from European works. Several of these early plates by Krieger appear in the Microscopist's report for 1893, and a number of others are in the files of the Mycological Collections of the Bureau of Plant Industry. During this period the young artist carefully saved the greater part of his annual stipend of \$1000, being aided and abetted therein by his parents who permitted him to live at home in Baltimore without charge for board or lodging, though it is recorded that difficulties were encountered in getting the young commuter up and away, particularly on cold winter mornings.

The Hon. J. Sterling Morton, Secretary of Agriculture, dropped the entire division on June 30, 1895, for the reason that its activities overlapped those of other divisions. Another position would have been found for Krieger, since his talents were recognized, but he preferred to seize the opportunity for a long planned period of foreign study. Accordingly he spent the year 1895-96 at the Royal Bavarian Academy of Fine Arts in Munich where he industriously applied himself to the work in hand, not overlooking, however, the splendid opportunities then afforded in the same city to the music lover. Following his return to America he was for some years an instructor of drawing and painting at the Baltimore institution where he had obtained his early training. He also established himself as a portrait painter, but although several portraits were executed successfully, he found it rather dull and welcomed the opportunity offered in 1912 to become mycological artist to Prof. Farlow of Harvard University.

During the ten year period that ensued, he gave himself wholeheartedly to the study of the fleshy fungi and to their accurate portrayal in color, under Dr. Farlow's immediate and sympathetic guidance. He worked for the most part in the famous library which adjoined Prof. Farlow's home in Cambridge, but also spent much time at Chocorua, New Hampshire, the Farlow summer home, a well known spot mycologically. Several hundred plates now in the collections of the Farlow Herbarium attest his artistic ability and technical accuracy. Some 24 of these plates were issued in 1929 as part of the posthumous volume edited by Dr. Burt, *Icones Farlowianae*, the exact plates involved being listed by Krieger under this reference in the bibliography of his *Popular guide to the higher fungi of New York* (14). It was during this time also that he commenced the indexing of the world's literature of the larger fungi to which task he devoted most of his leisure hours for more than thirty years. His recreation while a resident of Cambridge was the Boston Symphony Orchestra and other local musical organizations. He not only enjoyed the musical performances of others, but was himself a skilled pianist and violinist and a great lover of Beethoven, Bach, and other composers of symphonic music.

Leaving Dr. Farlow's service late in 1912, to again accept employment with the United States Department of Agriculture, Krieger was assigned to the Plant Introduction Garden at Chico, California. Here under the direction of the late David Griffiths he painted a remarkable series of pictures of the innumerable species and forms of the Cactus family assembled by Griffiths in connection with his studies of the forage possibilities of the prickly pears. These plates, largely unpublished, are deposited in the National Herbarium of the Smithsonian Institution, as part of the Griffiths' collections.

Although Krieger developed a great admiration for David Griffiths and came to like Chico and its environs, the mushrooms were his first love, and he enthusiastically welcomed the invitation of Dr. Howard A. Kelly, of Baltimore, to resume his study and portrayal of these interesting plants. He took up his work with Dr. Kelly in December 1918, and during the ensuing ten years painted

a second superb series of mushroom plates and continued intensive efforts to make his index comprehensive. It was during this, the halcyon period of his career, that he prepared and published most of his technical papers which appeared in *Mycologia* and other scientific journals. Prominent among them was the article *Common mushrooms of the United States* (3) in the *National Geographic Magazine* for May 1920 which was illustrated by 16 of his own colored plates. This article attracted widespread favorable comment from mycologists and laymen alike, and it is still a "best seller" with bookdealers who handle the *Geographic*. Another extremely interesting and instructive paper was his history of mycological illustrations (7) which attested not only his ability as a critic of mycological illustration, but his knowledge of the literature. Other papers described and discussed new or rare agarics and other fungi encountered among the many species collected as "models" for his plates. A number of popular articles contributed to the *Baltimore papers* testified to the breadth of his interests.

Not the least of his activities was his assistance to Dr. Kelly who was interested during this time in building up what became within a few brief years one of the finest private mycological libraries ever assembled. It included an excellent set of Saccardo's *Sylloge Fungorum*, a volume of original colored illustrations by Schweinitz, and many other fine items to a total of over 10,000. Krieger's work with this library was climaxed by his detailed and accurate catalogue of it, published by Dr. Kelly in 1924.

In 1928 Dr. Kelly decided the time had arrived to deposit his mycological library and fungus collections, including the Krieger paintings in an institution where they would be safely housed and readily available for use. The University of Michigan was selected and the transfer made under the direction of the late C. H. Kauffman where in accordance with Dr. Kelly's wish the collection was named "The L. C. C. Krieger Mycological Library," and Krieger was appointed Honorary Curator. His connection with Dr. Kelly ceased at this time, but it must be noted that the latter continued his friendship with him, and aided him in many ways during his later years.

Krieger served briefly in 1928-29 with the Tropical Plant Research Foundation in Cuba where with his usual skill he made a series of paintings of sugar cane diseases, several of which were published. Returning from his Antillean adventure through the interest of Dr. Kelly he became Mycologist to the New York State Museum at Albany, his primary objective being the preparation of a manual of the higher fungi of New York State to be illustrated in part by some of his own paintings. He undertook the task with his usual enthusiasm and within a year prepared the manuscript and illustrations of the volume (14) which after a long unaccounted for delay was issued in 1935 by the New York State Museum. This book was well written, carefully illustrated, and scientifically accurate and is one of the most satisfactory of the popular mushroom manuals ever issued in this country. It brought him many favorable comments although his satisfaction in his work was marred by the fact that the originals of the plates for which he felt responsible were lost or destroyed through the negligence of others.

For the third time Krieger entered Government service in 1929, largely as a result of the interest taken in him by his old friend, David Griffiths, who was now concerned with the development of an American bulb-growing industry. The artist's talents were employed to illustrate in color the flowers of the many varieties of bulbous plants involved in the project, and a number of these plates appear in Griffiths' publications on the subject. Later on the work became more diversified to include a wide range of horticultural and pathological subjects and many colored plates bearing the initials L. C. C. K. will be found in the Market Disease Handbook series and other publications of the Division of Fruit and Vegetable Crops and Diseases issued during recent years.

Although circumstances did not permit him to work at his favorite subject, Krieger retained his interest in the fleshy fungi and more especially in the genus *Boletus*. He was particularly skilled in identifying species in this difficult group and had accumulated a comprehensive set of notes covering the literature of the genus with the hope of preparing a monograph to be illustrated by his paintings which included some 80 species.

Unfortunately this plan never came to fruition, the infirmities of age and lack of funds preventing. Among his other unfinished works may be mentioned a panchromatic color atlas and a partially completed set of paintings to illustrate a proposed low cost popular mushroom manual, both of which are deposited in the Mycological Collections of the Bureau of Plant Industry.

At the time of his death he was a member of the Mycological Society of America, the Botanical Society of Washington, the Deutsche Gesellschaft für Pilzkunde and an honorary member of the California Mycological Society. During his career he had been a member of the New England Botanical Club, the Boston Mycological Club, the Botanical Society of America, and the Maryland Academy of Science. He married Agnes Checkley Keighler, April 4, 1904. She died in 1939 under tragic circumstances, which were a contributory factor to his own passing. A daughter, Agnes Checkley Krieger survives.

BUREAU OF PLANT INDUSTRY,  
WASHINGTON, D. C.

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## FOUR PHYCOMYCETES DESTRUCTIVE TO NEMATODES AND RHIZOPODS

CHARLES DRECHSLER

(WITH 5 FIGURES)

Agar plate cultures prepared in the isolation of oomycetes responsible for root rot and allied diseases of the higher plants often display, after aging a week or more, important biotic relationships among some of the various extraneous soil microorganisms that have managed to develop successfully in them. Pure cultures used in connection with studies on the morphology of the oomycetes in question—mainly species of *Pythium*, *Phytophthora*, and *Aphanomyces*—can often be made to display such relationships likewise if after serving their immediate purpose they receive an accession of decaying vegetable material. Through examination of cultures thus prepared, four additional Phycomycetes habitually subsisting by the destruction of minute terricolous animals have been discovered. While two of the additional forms differ from previously described members of the Zoöpagaceae only with respect to ordinary details of morphology, the other two forms reveal a type of asexual reproduction alien to all seven of the genera hitherto erected in the family. With accession of the four species herein to be described, the recorded membership of the Zoöpagaceae is increased to 42.

### A NEMATODE-CAPTURING PHYCOMYCETE WITH INTRAMATRICAL LATERAL CHLAMYDOSPORES

In an earlier summary (1: p. 269, figs. 15C, 15D; p. 270, lines 7 to 19) a *Pythium*-like fungus was briefly set forth that captures nematodes by adhesion to unseptate mycelial filaments about  $4\mu$  wide; the sigillate cushion of adhesive material operative in each instance of capture thereupon being pierced by an infective branch, which then penetrates the animal's integument and gives rise within the fleshy body to a system of assimilative hyphae. As regards

vegetative morphology and predaceous habit the fungus thus shows very obvious parallelism with the two robust nematode-capturing forms that I have elsewhere (4, 6) described as members of the Zoöpagaceae under the binomials *Stylopaga hadra* and *S. leiohypha*. However, its asexual reproduction by development of more or less intramatrical, mesially intercalary, globose conidia on creeping mycelial filaments differs rather markedly from the asexual reproduction by development of aerial conidia prevalent among the Zoöpagaceae. Because of their resemblance to the asexual spores of some familiar species of *Pythium*, as, for example, *P. ultimum* Trow, the intercalary globose conidia might readily be held to indicate taxonomic relationship in the Pythiaceae, to which family, indeed, the predaceous genus *Zoöphagus* has been assigned by most writers; though a more convincing interpretation of them can be derived by considering the indubitably homologous reproductive bodies produced by another nematode-capturing Phycomycete.

This Phycomycete of less ambiguous morphology developed in some fifty *Pythium* cultures on maize meal agar, to each of which had been added pinches of leaf mold from collections made during September 1939, near Butternut, Wis., and Haugen, Wis. Its hyphae, while of about the same width as those of *Stylopaga hadra*, show little of the haphazard ramification usual in the latter species, but, instead, grow out from their origin in sparse radial arrangement, sometimes pursuing a straightforward course for stretches of 10 mm. without giving off more than a half-dozen branches. It subsists, seemingly to the exclusion of all other sources of nourishment, by preying on eelworms; *Pectus parvus* Bastian being found captured most abundantly in my cultures. Capture is effected by adhesion to outwardly undifferentiated mycelial hyphae, the adhesive material soon becoming visible as a sizeable cushion of sigillate shape and golden yellowish coloration. An infective branch now pierces the adhesive cushion, penetrates the animal's integument, and then ramifies several times (FIG. 1, A, B) in giving rise to assimilative hyphae that extend themselves lengthwise through the fleshy body (FIG. 1, C, a, b; D-F). Often an eelworm is held in two (FIG. 1, B, E) or three (FIG. 1, F) places, and is invaded by a corresponding number of haustorial systems. Once the assimilative hyphae, which as in *S. hadra* are perceptibly narrower than the

mycelial threads, have depleted the animal of its digestible substance, their protoplasmic contents are withdrawn into the parent filament by way of the infective branch. Before long the collapsed integument and the evacuated haustorial membranes within it disappear from view completely, so that only a cicatrized stub of the infective branch, more or less imbedded in yellowish material (FIG. 1, *B*), remains as evidence of the animal's destruction. Protuberant stubs of such origin are usually not difficult to distinguish from the small lumps of adhesive substance often secreted by mycelial hyphae in positions near captured animals (FIG. 1, *C*, *E*).

To initiate development of asexual spores the long mycelial hyphae burgeon forth lateral processes here and there. Each process increases in size as it receives granular protoplasm supplied through progressive evacuation of the adjacent proximal and distal portions of the parent hypha; successive steps in this evacuation being marked by deposition of consecutive retaining septa (FIG. 1, *G*, *H*, *I*). Movement of the granular material seems to be rather slow, and apparently becomes still slower after a stage has been reached when all but a short segment of the parent hypha, sometimes not more than  $5\ \mu$  in length, has been evacuated (FIG. 1, *J*, *K*). In time, however, through gradual enlargement of a vacuole, this last hyphal segment likewise is emptied of protoplasm (FIG. 1, *L*, *M*), and a retaining wall is laid down whereby the evacuated filament is delimited from the sessile lateral body that constitutes the asexual spore (FIG. 1, *N-W*). Often, especially in elongated spores relatively narrow at the base, further withdrawal of protoplasm ensues, with the result that a unilocular or bilocular stalk-like basal part is also emptied of contents (FIG. 1, *X*, *Y*, *Z*, *AA*).

It is not evident that the stalk-like part, where present, serves to hold the reproductive body aloft in the air. Apparently the spores, whether stalked or sessile, are never formed as aerial structures, but are produced either in the substratum or directly on its surface. Unlike aerial conidia generally, including those of the Zoöpagaceae, they are not adapted for easy disarticulation. In the presence of active nematodes they sometimes secrete lumps of yellow adhesive material (FIG. 1, *Q*). On being transferred from stale cultures to comparatively fresh nematode-infested cultures, they germinate vegetatively by putting forth a sturdy hypha capable of capturing

prey. Irrigation with fresh water has not brought them to produce zoospores. Their intramatrical origin, as well as their variability with respect to size and shape, distinguish them from the aerial conidia of the genus *Endocochlus*, which they resemble somewhat in manner of development. In view of their general characteristics they would seem to represent chlamydospores rather than conidia.

The morphology of its vegetative stage, together with its predaceous habit, leaves little doubt that the fungus must belong in the Zoöpagaceae. To make provision in the family for members reproducing asexually by the development of intramatrical chlamydospores, a new genus is now proposed under a name compounded of two words meaning "bladder" and "trap" respectively. The epithet chosen for the species refers, of course, to the position of the reproductive bodies in relation to the hyphae on which they are borne.

#### **Cystopage gen. nov.**

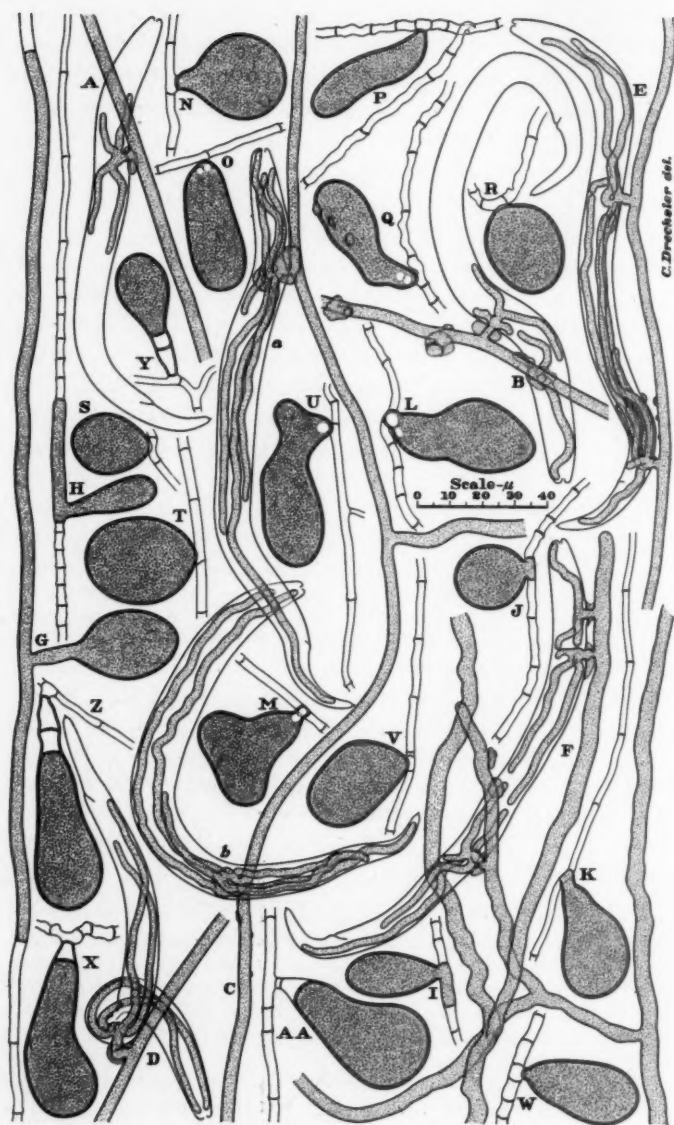
Mycelium hyalinum, plerumque parce ramosum; hyphis filiformibus, primo continuis, minuta animalia per adhaesionem capientibus, in ea penetrantibus, carnem eorum assumentibus, chlamydosporas terminalis vel intercalaris vel lateralis in matricem gignentibus.

Mycelium hyaline, usually rather sparingly branched; hyphae filamentous, at first continuous, capturing minute animals by adhesion, then penetrating into them and appropriating their fleshy contents; reproducing asexually by the development of terminal, intercalary, or lateral chlamydospores in or on the substratum.

#### **Cystopage lateralis sp. nov.**

Mycelium sparsum; hyphis 2.5–6  $\mu$  crassis, saepe recta procurrentibus, sine tuberibus vermiculos nematoideos tenentibus, integumentum eorum perforantibus, ramulos assumentis vulgo 2–3  $\mu$  crassos intus evolventibus qui carnem exhauriunt; chlamydosporis incoloratis, globosis, elongato-ellipsoideis, ovoideis, subinde lobulatis, plerumque 25–50  $\mu$  longis, 10–28  $\mu$  latis, semper a latere hyphae mycelii oriundis, fere sessilibus sed quandoque pediculo evacuato aptis.

Vermiculos nematoideos diversos praesertim *Plectum parvum* capiens consumensque habitat in humo silvestri prope Butternut, Wisconsin, et Haugen, Wisconsin.

FIG. 1. *Cystopage lateralis*.

Mycelium sparse; hyphae  $2.5\ \mu$  to  $6\ \mu$  wide, often straightforward for several millimeters, through adhesion capturing nematodes, then invading them without production of orbicular protuberances, the infective branch giving rise within to haustorial filaments commonly  $2\ \mu$  to  $3\ \mu$  wide, which assimilate the fleshy contents. Chlamydospores colorless, globose, elongate-ellipsoidal, ovoid, or somewhat lobate in shape, measuring mostly  $25\ \mu$  to  $50\ \mu$  in length by  $10\ \mu$  to  $28\ \mu$  in width, always formed laterally on mycelial hyphae, commonly sessile, but sometimes, following evacuation of a narrow proximal part, coming to surmount an empty unilocular or bilocular pedicel.

Capturing various nematodes, including especially *Plectus parvus*, it occurs in leaf mold near Butternut, Wis., and Haugen, Wis.

A RHIZOPOD-CAPTURING PHYCOMYCETE WITH INTRAMATRICAL  
CHLAMYDOSPORES

One of the cultures in which *Cystopage lateralis* grew out from deposits of leaf mold afforded also the development of a more minute but unquestionably congeneric fungus. This smaller form subsisted, apparently to the exclusion of other nourishment, by capture of a protozoan, elongated elliptical in outline, and measuring mostly  $25\ \mu$  to  $30\ \mu$  in length by  $11\ \mu$  to  $15\ \mu$  in width. When the animal, present abundantly both on and in the maize-meal-agar medium, first came under observation it was very inactive, and had at its anterior end a median indentation (FIG. 2, A, B) that gave it a frontal profile reminiscent of some flagellate protozoans belonging, for example, in the saprozoic genus *Chilomonas*. After portions of the material had been irrigated with fresh water the animal resumed a more active condition by largely obliterating its indentation and by extending from its median anterior region a branching system of delicate pseudopodial strands (FIG. 2, C, D). Though a membranous testa was not clearly distinguishable, the relatively stable conformation of the protozoan indicated the presence of a firm envelope. A spherical nucleus, about  $7\ \mu$  in diameter, and of an indistinctly granular structure throughout, usually occupied a position near the fundus (FIG. 2, A, C, D), though occasionally it could be seen nearer the middle of the body (FIG. 2, B). The animal apparently is referable to the genus *Lecythium*

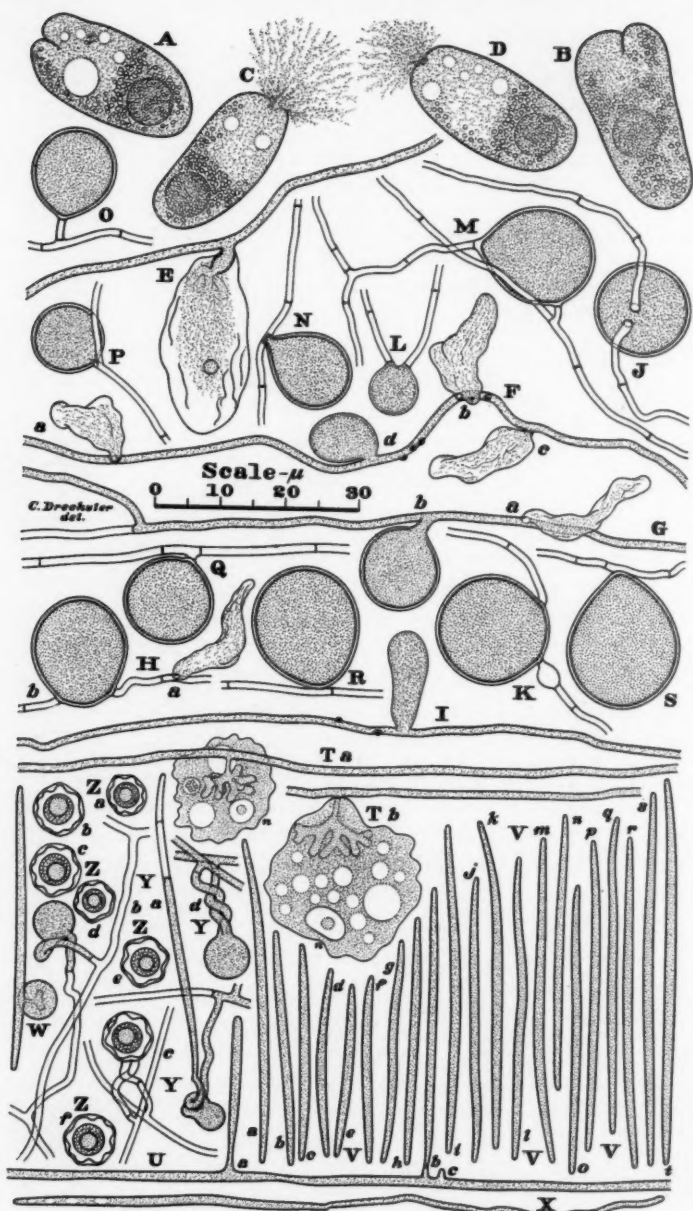


FIG. 2. A-S, *Cystopage subtilis*; T-Z, *Acaulopage stenospora*.

among the testaceous rhizopods, and in that genus would seem perhaps most similar to *L. mutabile* (Bailey) Hopk.

When specimens of the rhizopod have been captured by adhesion to the delicate mycelial hyphae of the fungus, they are soon expropriated of all protoplasmic contents. This is evidently accomplished by means of commonplace haustorial branches, though, owing to an unfavorable consistency of the sarcodae, such elements are in most instances only partially and indistinctly discernible (FIG. 2, *E*). The emptied testae remain attached to the hyphae as collapsed membranous envelopes (FIG. 2, *F*, *a*, *b*, *c*; *G*, *a*; *H*, *a*) not differing in appearance from collapsed pellicles of soil amoebae.

The fungus often initiates asexual reproduction, much like *Cystopage lateralis*, by putting forth lateral excrescences from its mycelial filaments (FIG. 2, *F*, *d*; *G*, *b*; *I*). In addition, the protoplasm of vegetative hyphae here often accumulates in intercalary swellings, or in swellings formed terminally on short lateral branches; so that when the adjacent portions of mycelium have yielded up their contents, subspherical chlamydospores are delimited in intercalary (FIG. 2, *H*, *b*; *J-M*), laterally intercalary (FIG. 2, *N*), and terminal (FIG. 2, *O*) relationships as well as in lateral (FIG. 2, *P-S*) relationship to the evacuated filaments. A very dense, almost imperceptibly granular internal texture, together with a faint smoky cast, gives the asexual spores an appearance suggestive of the ectoparasitic thalli of *Bdellospora helicoides* Drechsl. (2).

Differing markedly from *Cystopage lateralis* not only by its generally smaller dimensions, but also by the more varied mycelial relationships and more regularly subspherical shape of its chlamydospore, the fungus is described as a new species under a specific name having reference to the slenderness of its hyphae.

#### ***Cystopage subtilis* sp. nov.**

Mycelium sparsum; hyphis 1-1.5  $\mu$  crassis, parce ramosis, per adhaesionem animalcula tenentibus, protoplasma eorum assumentibus; chlamydosporis incoloratis vel minime fumidis, lateralibus vel intercalaribus vel rarius terminalibus, globosis vel paululum obovoideis, plerumque 7-20  $\mu$  diam.

Speciem *Lecythii* (*Lecythii mutabilis* adfinem) capiens consumensque habitat in humo silvestri prope Haugen, Wisconsin.

Mycelium sparse; hyphae  $1\mu$  to  $1.5\mu$  wide, sparingly branched, capturing minute animals through adhesion, and assimilating their protoplasmic contents; chlamydospores colorless or very faintly smoky, lateral or intercalary or more rarely terminal, subspherical or slightly obovoid, measuring commonly  $7\mu$  to  $20\mu$  in diameter.

Capturing and consuming a species of *Lecythium*, close to or possibly identical with *L. mutabile*, it occurs in leaf mold near Haugen, Wis.

#### ANOTHER SPECIES OF *ACAULOPAGE* WITH LONG SLENDER CONIDIA

A maize meal agar culture to which had been added some pinches of leaf mold collected in Arlington, Va., on Oct. 7, 1936, permitted the development of a species of *Acaulopage* that with respect to morphology would seem approximately intermediate between the two forms I described earlier (3) under the binomials *A. raphidospora* and *A. macrospora*. It subsists by capturing amoebae that usually measure  $15\mu$  to  $25\mu$  in diameter, and that usually contain a subspherical or ellipsoidal hyaline nucleus, often  $4\mu$  to  $6\mu$  long and  $3.5\mu$  to  $4\mu$  wide, within which a slightly darker "Binnenkörper," about  $1.8\mu$  in diameter, is distinguishable (FIG. 2, *Ta*, *n*; *Tb*, *n*). Capture is effected by adhesion to mycelial filaments markedly coarser than those of *A. raphidospora*, even if the differences in width amounts to less than a micron. The pellicle of the individual captive is soon pierced by a narrow infective branch, which after growing a short distance into the sarcode bifurcates several times to form a pedicellate haustorium with swollen digitate assimilative elements. The animal's contents become increasingly vacuolate (FIG. 2, *T*, *b*) and eventually disappear completely.

With adequate nourishment the superficial hyphae of the fungus send up erect filamentous processes (FIG. 2, *U*, *a*) each of which, on attaining definitive length, undergoes division into a long slender aerial conidium and a short basal sterigma (FIG. 2, *U*, *b*, *c*). In general, the conidia thus formed (FIG. 2, *V*, *a-t*) are longer but not wider than the homologous bodies of *Acaulopage raphidospora*. On the whole, again, they are appreciably narrower and shorter than the conidia of *A. macrospora*, and would seem to be lacking, besides, in any tendency either toward distal bifurcation or toward

evacuation at the ends. A conidium, after falling on the substratum, often begins predaceous activity directly by intruding a haustorium into an amoeba adhering to it (FIG. 2, *W*). Germination regularly takes place by emission of a germ hypha (FIG. 2, *X*) capable of holding prey.

The germ tube from a conidium often assumes a sexual function by uniting with a zygomorphic branch from a mycelial hypha to initiate development of a zygosporangium (FIG. 2, *Y, a*). In these instances, as also when the paired zygomorphic branches arise from two separate mycelial hyphae (FIG. 2, *Y, b, c*), some meager reciprocal engagement of the conjugating elements is usual. This engagement only occasionally appears as helicoid intervolution (FIG. 2, *Y, d*). The zygosporangium formed at the junction of the sexual branches is a smooth subspherical body. At maturity its envelope collapses about the prominently warty zygosporangium formed within it (FIG. 2, *Y, c; Z, a-f*). Both zygosporangium and zygosporangium are noticeably larger than the corresponding structures of *A. raphidospora*.

A term compounded of two words meaning "narrow" and "seed," respectively, is deemed a suitable specific name for the fungus.

#### ***Acaulopage stenospora* sp. nov.**

Mycelium sparsum; hyphis incoloratis, filiformibus, parce ramosis, 1-1.5  $\mu$  crassis, ad animalcula haerentibus, pelliculam eorum perforantibus, haustorium intus evolventibus quod protoplasma exhaurit; haustorio pediculato, pediculo circa 2-3  $\mu$  longo, .7  $\mu$  crasso, apice abrupte latescente, vulgo bis vel ter repetite bifurco, ita usque 8 ramulos divaricatos, circa 1.3  $\mu$  crassos ferente. Conidia hyalina, filiformia, recta vel leniter curvata, utrimque parvo attenuata; plerumque 25-60  $\mu$  longa, 1.2-1.6  $\mu$  crassa, ex sterigmatibus circa 2  $\mu$  altis et 1  $\mu$  latis assurgentia. Hyphae zygosporiferae modo ex hypha mycelii modo ex conidio germinanti oriundae, vulgo 10-30  $\mu$  longae, 1-1.5  $\mu$  crassae, saepius inter se paulum intricatae; zygosporangio primum levi, sphaeroideo, 6-8  $\mu$  diam., maturitate membrana circa zygosporam laxa collapsa; zygospora flavida, globosa, 5.5-7.5  $\mu$  diam., membrana .5-1.5  $\mu$  crassa, 10-25 verrucis ornata.

Amoebas 5-25  $\mu$  latas capiens consumensque habitat in humo silvestri in Arlington, Virginia.

Mycelium sparse; hyphae colorless, filiform, sparingly branched, 1  $\mu$  to 1.5  $\mu$  wide, adhering to minute animals, perforating the pellicle of each captive, and intruding a haustorium into the sarcode;

haustorium pedicellate, its pedicel, about  $2\mu$  to  $3\mu$  long and  $0.7\mu$  thick, widening abruptly and usually bifurcating successively 2 or 3 times to bear as many as 8 divergent branches about  $1.3\mu$  wide. Conidia colorless, filiform, straight or slightly curved, tapering somewhat at both ends, measuring mostly  $25\mu$  to  $60\mu$  in length by  $1.2\mu$  to  $1.6\mu$  in greatest width, borne erect on sterigmata about  $2\mu$  high and  $1\mu$  wide. Zygothoric hyphae commonly  $10\mu$  to  $30\mu$  long,  $1\mu$  to  $1.5\mu$  wide, usually only rather slightly intricate, arising from mycelial filaments or from germinating conidia; zygosporangium subspherical,  $6\mu$  to  $8\mu$  in diameter, at first smooth, its envelope at maturity collapsing loosely about the zygosporangium; the latter yellowish, globose,  $5.5\mu$  to  $7.5\mu$  in diameter, surrounded by a wall measuring  $0.5\mu$  to  $1.5\mu$  in thickness inclusive of its 10 to 25 warty protuberances.

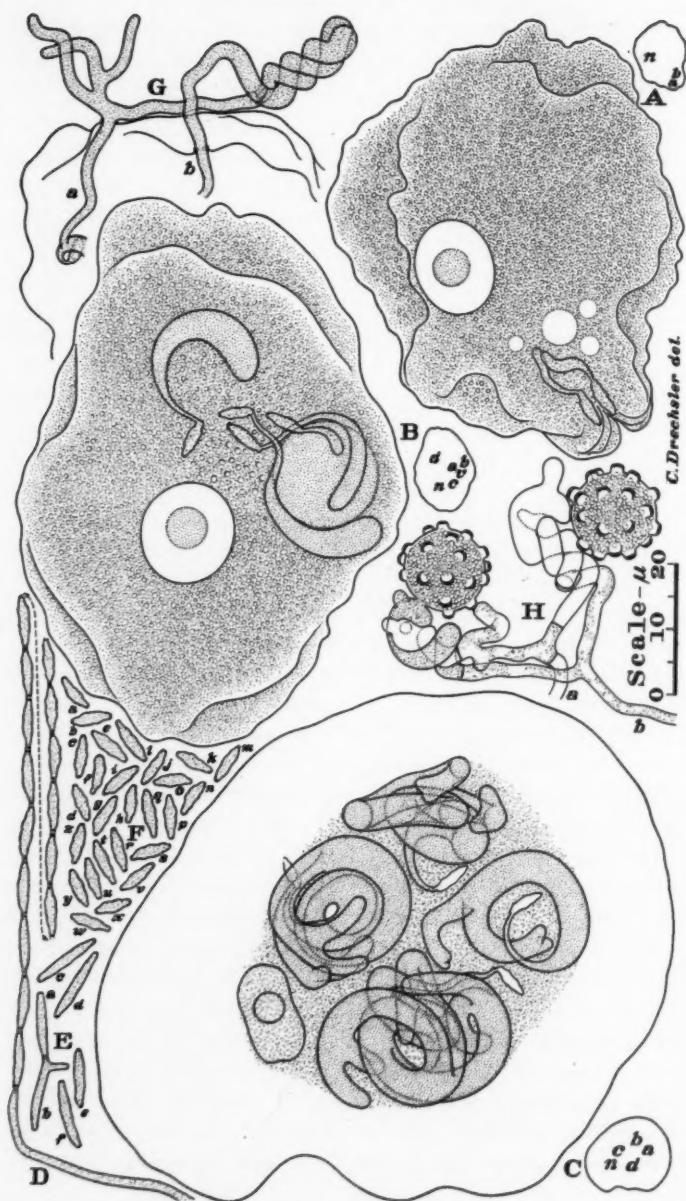
Capturing and consuming Amoebae  $5\mu$  to  $25\mu$  wide it occurs in leaf mold in Arlington, Virginia.

#### A SPECIES OF COCHLONEMA WITH IRREGULARLY CONVOLVED THALLI

In a maize meal agar culture to which had been added small quantities of leaf mold collected near Haugen, Wis., during September 1939, numerous large amoebae were found parasitized by a species of *Cochlonema* whose luxuriant tufts of conidial chains become visible to the naked eye as minute white flecks distributed here and there over the surface of the medium. The animals attacked commonly measured  $60\mu$  to  $75\mu$  in diameter when drawn into a more or less compact form, and were surrounded by a relatively thick pellicle cast in broad, boldly undulating pseudopodial folds. They consistently revealed imbedded in the granular sarcoderm a prolate ellipsoidal nucleus (FIG. 3, A, n; B, n), often about  $15\mu$  long and  $12\mu$  to  $14\mu$  wide, within which a lighter hyaline outer layer could be distinguished from a slightly darker subspherical central body, or "Binnenkörper," approximately  $6\mu$  in diameter. All the animals attacked clearly belonged to the same species of *Amoeba* that earlier was recorded (5, 9) as being subject to destruction by the two fungi I described under the binomials *Dactylella tylopaga* and *Cochlonema megalosomum*. This species of *Amoeba* was designated in my earlier papers as *A. verrucosa* Ehrenb., and consistency, at least, will be served by applying the same name also in the present account.

The host animal unwittingly initiates its own destruction by ingesting conidia of the parasite strewn about on the surface of the substratum. Each ingested spore soon germinates in extending, usually from near one of its ends, a delicate germ tube that gradually widens as it elongates (FIG. 3, *A*, *a*, *b*). However, the young thallus is ordinarily not left to batten undisturbed, for during the earlier stages of infection, the contractile vacuole of the host repeatedly expands in contact with it. In instances of plural infection the expanding vacuole often engages several young thalli, which then usually become more or less entangled with one another (FIG. 3, *B*, *a*, *b*, *c*). Discharge of the contractile vacuole abruptly moves the engaged thalli to a peripheral position in the sarcode, whence the animal seemingly attempts to void them by means of a purse-lipped protrusion (FIG. 3, *A*). On failure of the attempt the enlarging contractile vacuole engages the thalli anew in another effort at their expulsion. Although no instances of successful avoidance came under observation, it seems not unlikely that defensive efforts so persistent may at times have a favorable issue. At all events the animal's apparent determination to resist destruction by the parasite under discussion contrasts markedly with its submissive attitude towards *Cochlonema megalosomum*, as well as with the resigned behavior of numerous other rhizopods towards zoopagaceous forms subsisting on them. The show of resolute opposition recalls Penard's (10) early record of successful defensive action by *Amoeba alba* Greeff in eliminating, through abstriction, sizable thalli of the fungus that he designated as *Saprolegnia* B, and that almost certainly must have been a member of the Zoopagaceae.

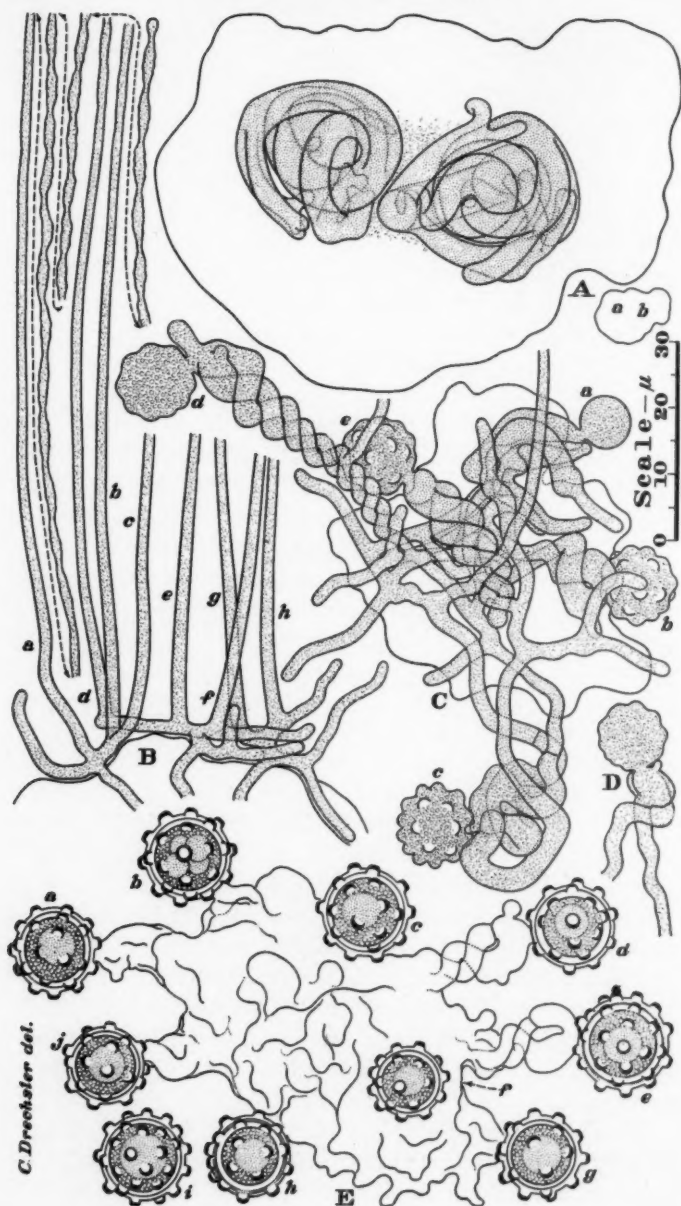
While it remains uncertain whether any morphological effect can be attributed to the stretching action exerted by the repeated expansion of the contractile vacuole, there can be no doubt that the narrow proximal portion of the thallus is much more prolonged in the fungus under consideration than in related species. It appears more probable that the morphology of the parasite may be influenced somewhat directly by the "rolling" locomotion of the animal. Because of such locomotion the growing thallus is constantly tumbled about, with the result that its tendency toward spiral convolvment, rather clearly expressed through the stages of

FIG. 3. *Cochlonema symplorum*.

elongation marked by the first and second dichotomies (FIG. 3, *B, d; C, a, b, c*), shows increasing irregularity in the further growth increments present in the relatively large clew-like thallic coils having three successive bifurcations (FIG. 3, *C, d; FIG. 4, A, a, b*). The appearance of disorderly development is heightened in plurally infected animals, since here the several thalli very often become intertangled into a confused snarl. In any case, regardless of the number of thalli at hand, the protoplasm of the amoeba undergoes steady reduction. The degenerating host nucleus remains recognizable until an advanced stage of expropriation has been reached (FIG. 3, *C, n*), but ultimately it, too, disappears from view (FIG. 4, *A*).

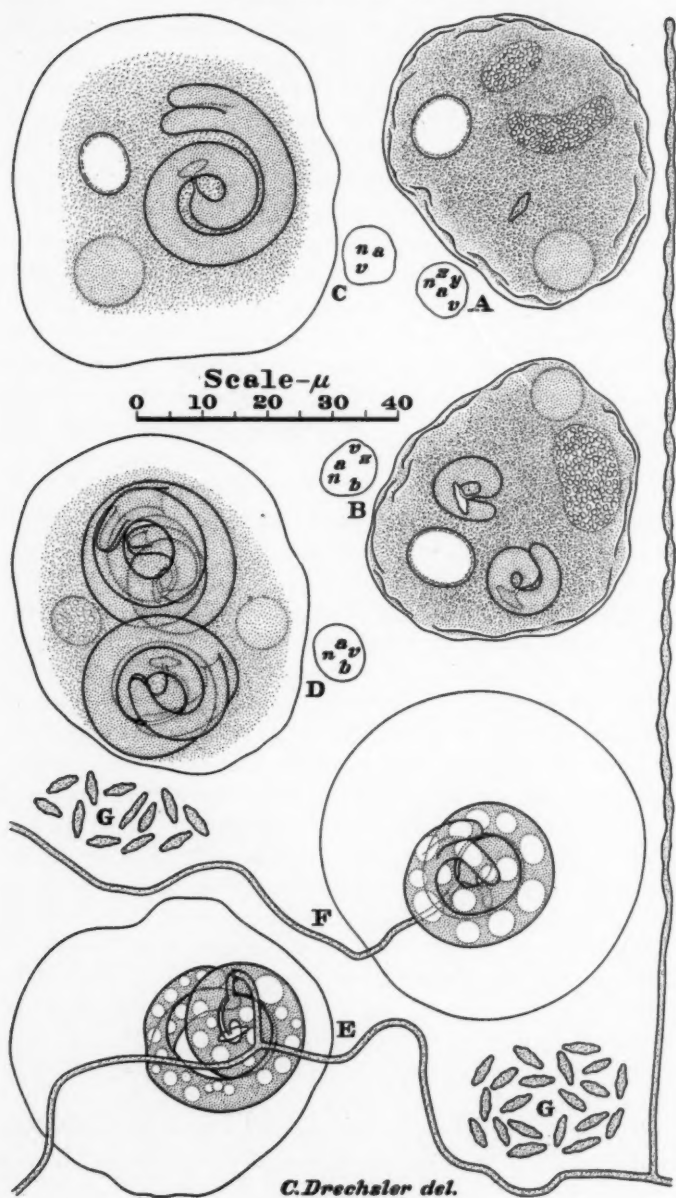
As has been intimated, the parasite gives rise to scattered white tufts consisting of long intertangled conidial chains. In the individual chain the component conidia are found united by short empty isthmi (FIG. 3, *D*). The spores in the lower portions of a chain (FIG. 3, *E, a-f*) are generally longer, narrower, and less pronouncedly verrucose than those in the median and distal portions (FIG. 3, *F, a-z*). Examination of asexual reproductive apparatus in earlier stages of development revealed that the chains are formed by segmentation of erect filaments whose smooth basal portions are little given to variations in width, but whose verrucose median and distal portions consist of expanded parts alternating with contractions (FIG. 4, *B, a*). The number of conidiiferous filaments or of conidial chains in a tuft, often between 8 and 12, is governed mainly by the size of the host animal, rather than by the number of thalli responsible for its destruction. Apparently each thallus puts forth a single reproductive hypha, which, after growing through the host pellicle, branches out laterally to give rise to conidiiferous filaments in such numbers as the quantity of available protoplasm permits: two, three, or perhaps four coming from thalli of moderate size that had been constrained to share the substance of their host with several fellows (FIG. 4, *B, a-c; d-f; g-h*); ten or perhaps more coming from thalli that had undergone no competition.

Sexual reproduction of the parasite was not observed in the culture for several days, until rather suddenly, while the material was being studied, it began simultaneously on an extensive scale. The

FIG. 4. *Cochlonema sympllocum*.

abrupt turn from asexual development probably was due to a marked fall in the temperature of the laboratory, resulting accidentally from failure of the heating system during cold weather. Apparently the fungus, like most other endoparasitic members of the Zoöpagaceae, is heterothallic, since its zygospores have been found produced only around pellicles occupied by plural thalli, and since, moreover, paired zygophoric hyphae have regularly been found arising from separate thalli wherever their connections were not too badly obscured through excessive entanglement of vegetative and reproductive parts (FIG. 3, *G, a, b*; *H, a, b*; FIG. 4, *C*). With respect to origin the zygophoric hypha is closely similar to the conidiiferous filament, as it likewise either represents a branch given off outside the pellicle by the single reproductive filament arising from the proximal portion of a thallus (FIG. 3, *G, a*), or consists of an external prolongation of the reproductive filament (FIG. 3, *G, b*). On making contact with each other paired zygophoric hyphae continue to grow, widening rather markedly and often winding about one another in as many as five helicoid turns before fusing apically (FIG. 3, *G, H*; FIG. 4, *C, d, e*). Where the sexual hyphae are not spirally interinvolved, they usually show some reciprocal engagement of a more irregular kind (FIG. 4, *C, a, b, c*; *D*). A septum is laid down in each hypha, cutting off all or most of its widened interinvolved terminal portion as a gametangium (FIG. 3, *G*). From the place of union between the sexual elements, or in close proximity thereto, the zygosporangium buds forth as a subspherical body, smooth during its earlier stages of enlargement (FIG. 4, *C, a*), but later becoming rather boldly verrucose (FIG. 4, *C, b-e*; *D*); one or both of the gametangia often giving rise, in the meantime, to a distal diverticulum of variable size (FIG. 4, *C, d*). When the zygosporangium has received the entire contents of the two gametangia, it lays down a basal septum (FIG. 3, *H*), and forms internally a zygospore surrounded by a wall rather indistinctly separated from its own (FIG. 4, *E, a-j*). At maturity the zygospore reveals a central reserve globule (FIG. 4, *E, a, c-j*), or occasionally several reserve globules (FIG. 4, *E, b*), surrounded by a coarsely granular parietal layer.

The fungus invites comparison more especially with *Cochlonema verrucosum* Drechsl. (2). As that species was described from a

FIG. 5. *Cochlonema verrucosum*.

single culture in which the few specimens of the host animal remaining alive when observations began were already in advanced stages of infection, it may be opportune to give some further details obtained through examination of material in a culture subsequently prepared with leaf mold originating from Arlington, Va., late in October 1937. During early stages of infection, before any pronounced pathological changes had become apparent, the rather slightly prolate nucleus of the host amoeba contained close under its delimiting membrane a narrow, somewhat interrupted layer of perceptibly darker material (FIG. 5, *A*, *n*; *B*, *n*; *C*, *n*). In its normal internal organization, therefore, the nucleus here would seem to resemble the larger and conspicuously more prolate nucleus of *Amoeba terricola* Greeff (*sensu strictiore*), the animal set forth in previous papers as subject to destruction by three zoöpagaceous forms I described under the names *Endocochlus gigas* (7), *Cochlonema megaspirema* (8), and *Acaulopage marantica* (9). Most assuredly, at all events, it differs in internal organization from the nucleus of *Amoeba verrucosa*. Apart from nuclear morphology, the host of *C. verrucosum*, provisionally identified as *Amoeba sphaeronucleolus* Greeff, appears clearly distinguishable from both *Amoeba terricola* and *Amoeba verrucosa* by its smaller dimensions and its thinner, more delicately undulous pellicle.

Although in the later material of *Cochlonema verrucosum* some thalli were found that had made nearly three spiral turns (FIG. 5, *D*, *a*, *b*; *E*; *F*) and had bifurcated once or twice, the distal coils showed no less geometrical symmetry than the proximal coils. At its proximal end the individual thallus always widened out abruptly from a short delicate germ tube. The single reproductive hypha produced by it was appreciably less robust than the corresponding filament in the related parasite from Wisconsin; and the conidia (FIG. 5, *G*) formed through segmentation of aerial branches put forth by this hypha appeared to be of somewhat smaller size than the asexual spores of the congeneric species.

The fungus from Wisconsin is therefore presented as a new member of the genus *Cochlonema*. An epithet meaning "interwoven" or "entwined" is deemed aptly descriptive both of its vegetative and of its sexual stage.

***Cochlonema symplocum* sp. nov.**

Hyphae alitae  $2.5-6.5\ \mu$  latae, basi paulatim latescentes, vulgo semel vel ter dichotomae, semel vel ter spiraliter convolutae vel saepe irregulariter glomeratae. Conidia hyalina, plerumque verrucosa, fusioidea, utrimque obtusa,  $6-12\ \mu$  longa,  $1.5-2\ \mu$  crassa, in catenulas assurgentis saepius circa  $500\ \mu$  longas digesta, in quaque catenula vulgo quinquagena usque septuagena. Hyphae zygosporiferae  $20-50\ \mu$  longae, basi circa  $2\ \mu$  crassae, sursum latescentiae, apice  $4-5\ \mu$  crassae, binae ex duabus hyphis alitis enatae, saepius bis subinde etiam quinquies inter se circumplicantes. Zygosporangia sphaeroidea, saepius  $11-14\ \mu$  crassa,  $20-35$  verrucis applanatis  $1\ \mu$  altis  $1.8\ \mu$  latis ornata. Zygosporae flavidae, membrana paene cum membrana zygosporangii concreta, loculum  $8-10\ \mu$  crassum circumdante.

*Amoebam verrucosam* enecans consumensque habitat in humo silvestri prope Haugen, Wisconsin.

Vegetative hyphae  $2.5\ \mu$  to  $6.5\ \mu$  in diameter, usually widening very gradually at the base rather than abruptly, simple or more often repeatedly dichotomous up to 3 times, sometimes wound into a fairly regular spiral coil of 1 to 3 turns, and sometimes convolved into a rather irregular clew. Conidia hyaline, mostly warty, spindle-shaped, blunt at both ends,  $6\ \mu$  to  $12\ \mu$  long,  $1.5\ \mu$  to  $2\ \mu$  wide, commonly formed in numbers from 50 to 70 in fairly erect chains measuring often about  $500\ \mu$  in length. Zygomorphic hyphae  $20\ \mu$  to  $50\ \mu$  long, approximately  $2\ \mu$  in diameter at the base, widening to a diameter of  $4\ \mu$  to  $5\ \mu$  at the apex, those of each conjugating pair arising from separate vegetative hyphae, and often winding about one another in 2 or even as many as 5 helicoid turns. Zygosporangium formed close to junction of the sexual hyphae, usually  $11\ \mu$  to  $14\ \mu$  in diameter, ornamented with 20 to 35 warty protuberances which are somewhat flattened on top and measure about  $1\ \mu$  in height by  $1.8\ \mu$  in basal width; its envelope often not distinctly separated from the wall of the yellowish zygosporangium, wherein is contained a spherical protoplast  $8\ \mu$  to  $10\ \mu$  in diameter.

Destroying *Amoeba verrucosa* it occurs in leaf mold near Haugen, Wis.

DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES,  
BUREAU OF PLANT INDUSTRY,  
U. S. HORTICULTURAL STATION,  
BELTSVILLE, MARYLAND

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## EXPLANATION OF FIGURES

FIG. 1. *Cystopage lateralis*; drawn to a uniform magnification with the aid of a camera lucida;  $\times 500$  throughout. A, Portion of mycelial filament with a captured specimen of *Plectus parvus*; an infective branch has penetrated into the nematode, and is extending assimilative hyphae through the fleshy interior. B, Portion of mycelial filament with a captured specimen of *P. parvus*; into the animal have been intruded two infective branches both of which are extending assimilative hyphae through the fleshy body; on the mycelial filament are shown imbedded in deposits of adhesive material cicatrized stumps of two infective branches. C, Portion of a long mycelial filament on which two specimens, *a* and *b*, of *P. parvus* have been captured; each of the animals is permeated internally by a haustorial system extending from head to tail. D, Portion of mycelial filament with a captured specimen of *P. parvus*; assimilative hyphae have been extended almost throughout the contorted body of the captive. E, Portion of mycelial filament from which two haustorial systems have been extended into a captured specimen of *P. parvus*; three small lumps of adhesive material are shown attached to the mycelial filament, and one lump is shown adhering to the animal's integument. F, Portion of mycelium whereon a specimen of *P. parvus* has been captured by adhesion in three places; three haustorial systems are being extended into the fleshy body. G, An extensive portion of mycelial filament that is giving rise to a stalked chlamyospore. H, I, Portions of mycelial filaments showing rather advanced stages in migration of hyphal contents into lateral chlamyospores of relatively small size. J-M, Late stages in migration of hyphal contents into lateral chlamyospores; only a short seg-

ment of the parent filament remains continuous with each of the developing spores. *N-W*, Chlamydospores wholly lateral in position, no longer including any portion of the parent filament; one specimen, *Q*, has three lumps of adhesive material attached to it. *X*, Chlamydospore connected with the parent filament by an empty basal cell. *Y, Z, AA*, Chlamydospores connected to the parent filament by two empty basal cells resulting from progressive evacuation of basal portions.

FIG. 2. Drawn to a uniform magnification with the aid of a camera lucida;  $\times 1000$  throughout. *A-S*: *Cystopage subtilis*. *A, B*, Specimens of the protozoan prey, possibly *Lecythium mutabile* (Bailey) Hopk., as found in a rather dry agar medium. *C, D*, Specimens of the protozoan prey 12 hours after moistening the agar medium with fresh water. *E*, Portion of hypha on which a specimen of the protozoan has been captured. *F*, Portion of hypha to which are attached membranous remains of three captured animals, *a-c*, as well as four lumps of adhesive material; a chlamydospore, *d*, is shown in an early stage of development. *G*, Portion of a branching hypha with membranous remains of a captured animal, *a*; a young chlamydospore, *b*, is being formed terminally on a short stalk. *H*, Portion of an empty hypha, to which is attached the collapsed envelope of a captive, *a*; and on which is borne a mature, laterally intercalary chlamydospore, *b*. *I*, Portion of hypha with a chlamydospore in early stage of development; two small lumps of adhesive material are shown attached. *J-M*, Portions of empty hypha, each bearing a mature intercalary chlamydospore. *N*, Portion of empty hypha with a mature chlamydospore in laterally intercalary relationship. *O, P*, Portions of empty hyphae, each with a mature chlamydospore borne terminally on a short lateral spur. *Q, R, S*, Portions of empty hyphae, each bearing laterally a mature sessile chlamydospore.

*T-Z*: *Acaulopage stenospora*. *T, a, b*, Portions of mycelial filament, from each of which a dichotomously branching haustorium has grown into a captured amoeba; *n*, nucleus of each captive. *U*, Portion of superficial hypha bearing a conidium, *a*, in early stage of development, as well as a fully formed conidium, *b*, and a denuded sterigma, *c*. *V, a-t*, Conidia showing variations in size and shape. *W*, Conidium from which a small haustorium has been intruded into a minute amoeba adhering to it. *X*, Conidium germinating by the production of a germ hypha. *Y*, Four units of sexual apparatus showing: *a*, early stage in development of a zygosporangium, following union of a sexual hypha contributed by a germinating conidium with a sexual branch arising from a mycelial filament; *b*, immature zygosporangium formed by union of paired sexual branches arising from separate mycelial filaments; *c*, mature zygosporangium originating from conjugation of paired sexual branches contributed by two separate mycelial filaments; *d*, immature zygosporangium formed at junction of two zygomorphic branches that wind about one another more extensively than is usual in the species. *Z, a-f*, Mature zygosporangia, enveloped in the zygosporangial membrane, showing differences in size and sculpturing.

FIG. 3. *Cochlonema symplocum*, drawn to a uniform magnification with the aid of a camera lucida;  $\times 1000$  throughout. *A*, Specimen of *Amoeba verrucosa* infected with two germinating conidia, *a* and *b*, which it apparently is attempting to void; *n*, nucleus of host animal. *B*, Specimen of *A*.

*verrucosa* infected with four young thalli of the fungus, *a-d*; *n*, host nucleus; *v*, contractile vacuole of host. *C*, Disabled specimen of *A. verrucosa* whose protoplasmic materials have been largely appropriated by four thalli of the parasite, *a-d*; *n*, host nucleus in somewhat degenerate condition. *D*, A sporiferous hypha bearing a long chain of conidia, of which only the lowermost 15 individuals are shown. *E*, *a-f*, Longish conidia from basal portion of conidial chains; the presence of a spur in *b* being due to branching of the sporogenous filament. *F*, *a-z*, Conidia from median and distal portions of chains, showing variations in size and shape. *G*, Pair of intertwined zygosporic hyphae that have their origin in the separate reproductive filaments *a* and *b*. *H*, Two units of sexual apparatus with full grown zygosporangia, each resulting from union of paired zygophoric hyphae coming from the separate reproductive filaments *a* and *b*.

FIG. 4. *Cochlonema symplocum*, drawn to a uniform magnification with the aid of a camera lucida;  $\times 1000$  throughout. *A*, Pellicle of a specimen of *Amoeba verrucosa*, whose protoplasm, except for a meager remnant, has been consumed in the development of the two large thalli *a* and *b*. *B*, Origins of eight growing conidiiferous hyphae, *a-h*; *a-c* resulting from ramification, outside the host pellicle, of one reproductive hypha; *d-f* resulting from branching of a second reproductive hypha; *g* and *h* resulting from ramification of a third reproductive hypha. One of the eight hyphae, *a*, is shown completely in four parts connected by broken lines. *C*, Five immature zygosporangia, *a-e*, derived from union of paired zygophoric hyphae having separate origins; at both *a* and *c* a supernumerary zygophoric hypha is present, though not functional. *D*, Young sexual unit with little involution of zygophoric hyphae. *E*, Ten mature zygosporangia, *a-j*, surrounding the collapsed pellicle of a large specimen of *A. verrucosa*.

FIG. 5. *Cochlonema verrucosum*, drawn to a uniform magnification with the aid of a camera lucida;  $\times 1000$  throughout. *A*, Specimen of host amoeba in active condition: *a*, ingested conidium of parasite; *n*, nucleus of host animal; *v*, contractile vacuole; *y*, *z*, digestive vacuoles containing numerous ingested bacteria. *B*, Specimen of host amoeba in active condition: *a*, *b*, two small thalli of the parasite, with empty conidial envelopes attached to them; *n*, host nucleus; *v*, contractile vacuole; *z*, large digestive vacuole containing numerous ingested bacteria. *C*, Specimen of host amoeba nearly disabled from loss of contents: *a*, thallus of parasite; *n*, host nucleus; *v*, contractile vacuole. *D*, Specimen of host amoeba nearly disabled as result of infection: *a*, *b*, two large thalli of parasite; *n*, degenerating host nucleus with lumpy internal structure; *v*, contractile vacuole. *F*, Thallus of parasite from which a reproductive filament has grown out through the enveloping pellicle of the host to produce conidial chains externally. *E*, Well developed thallus from which a reproductive filament has grown out to produce erect conidiiferous hyphae, of which one is shown. *G*, Detached conidia, showing variations in size and shape.

## STUDIES IN THE GASTEROMYCETES II. BOVISTINA, A NEW GENUS

W. H. LONG AND DAVID J. STOFFER

(WITH 1 FIGURE)

The Gasteromycete here described was discovered by the writers while on a collecting trip in the Woodland Forest type near Corona, New Mexico. The plant was mistaken for a *Bovista* hence did not attract any special attention when collected. Sixty plants were found scattered over several yards in the old exposed duff of a Juniper which had been recently removed for cord wood. Four other specimens were also obtained in the same general region.

The plant externally is a typical *Bovista*, but internally it has the glebal characters of a *Geaster*; a very unique combination and one not previously known to science. It is therefore made the type of a new genus.

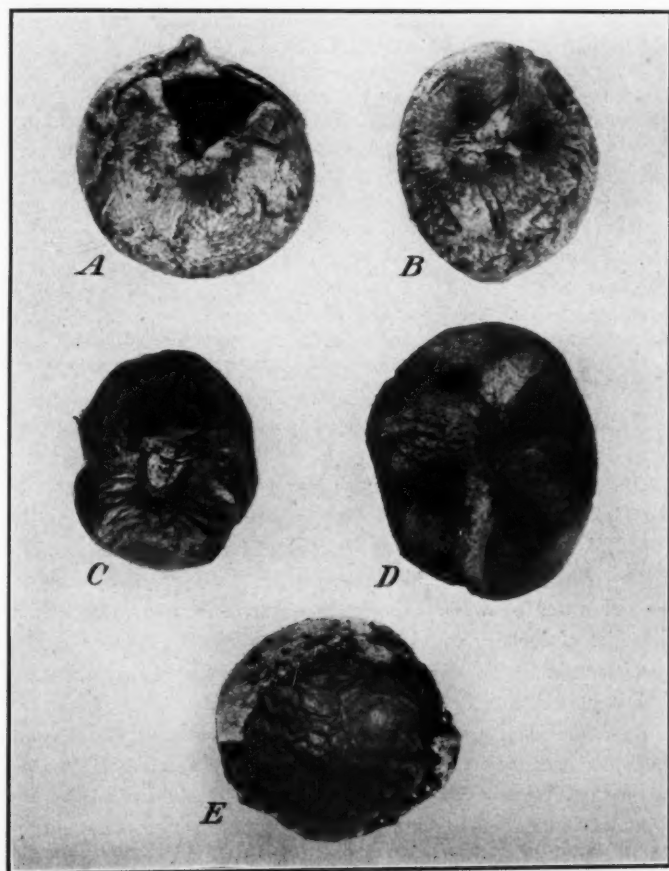
### **Bovistina** gen. nov.

*Sporophore* irregular globose (FIG. 1, *B, D*) to depressed-globose (FIG. 1, *A, C, E*), sessile; *peridium* of two distinct layers (FIG. 1, *A, E*) an *exoperidium* and an *endoperidium*; *exoperidium* membranous, deciduous at maturity; *endoperidium* membranous or papyraceous, with a metallic luster, dehiscing by a single, apical orifice, sterile base none; *gleba* of *capillitium* and spores; *capillitium* of long, unbranched, *Geaster*-like threads arising from the inner walls of the *endoperidium*, non-septate, colored; *spores* globose, continuous.

Forma, habitas et peridium ut in genere *Bovistae*; gleba e capillitio et sporis constans; capillitium e filamentis longis, simplicibus, his *Geastri* similibus, e parietibus interioribus *endoperidii* ortis, eseptatis, coloratis compositum; sporae globosae, continuae, coloratae.

### **Bovistina atrogleba** sp. nov.

*Sporophore* 1-3 cm. in diameter, hypogeous, usually depressed-globose, with a universal mycelium; *exoperidium* with scattered particles of soil adhering to entire surface which easily rub off,

FIG. 1. *Bovistina atrogleba*.

white aging to light tan, brittle, up to 0.25 mm. thick, slowly flaking away at maturity (FIG. 1, E); *endoperidium* very thin, easily torn, flaccid, papyraceous, smooth, dull lead-colored, dehiscing by an irregular to elliptical plane to depressed, naked mouth (FIG. 1, A, B, C), which may become large and strongly lacerate with age (FIG. 1, A, D), often with small, white, floccose fragments of the exoperidium clinging to the margin of the orifice (FIG. 1, B, C); *gleba* dark brown to soot-black (FIG. 1, A), columella absent; *capillitium*, threads straight, apically acuminate, 1-4 mm. long, ex-

tending in compact masses of parallel hyphae inward to the center of the sporocarp, remaining lightly attached to its wall at maturity, breaking away under weathering, threads smooth, not easily fragmenting, amber-colored under the microscope, usually thinner than the spores, 4-7 microns thick, very abundant, walls thick, not pitted; *spores* globose, 5-9 microns in diameter including the verrucae, opaque (in water mountant), apiculate, with a short, hyaline apiculus (the stump of the pedicel); *episore* dark chestnut brown, covered with coarse, subhyaline verrucae which are blunt, cog-like, up to 1.4 microns long by 1.1 microns wide, often deciduous.

*Sporophora* 1-3 cm. in diam., depresso-globosa; *exoperidio* albo; *endoperidio* tenuissimo, flaccido, glabro, plumbeo; *ore* ex irregulari elliptico; *gleba* atrobrunnea; *filamentis* capillitii rectis, 1-4 mm. longis, paralliter compactis, glabris, succineis, copiosis; *sporis* globosis, 5-9 microns in diam., atrocasteneis, valde verrucosis.

**HABITAT:** Solitary or gregarious in the vegetable debris under trees of *Juniperus monosperma*.

**DISTRIBUTION:** New Mexico, Lincoln County, near Corona, in the Gallinas Pinon-Juniper Forest, elevation 7100 ft. April 21, 1940, *W. H. Long & David J. Stouffer* (Nos. 8736 & 8744). The Type collection, No. 8736, consisting of *sixty specimens*, is deposited in the following herbaria, *50 plants* in the Long Herbarium, *5* in the University of California Herbarium at Berkeley, and *5 specimens* in the Mycological Collections of the Bureau of Plant Industry.

*Bovistina* is very similar in shape and peridia to *Bovista* and *Lanopila* but differs markedly in capillitial characters; *Bovistina* has a capillitium of long, unbranched, *Geaster*-like threads arising from the inner walls of the endoperidium; *Bovista* has a capillitium of discrete branched units; while *Lanopila* has long, sparingly branched, *Calvatia*-like threads, which at maturity are easily broken into short segments.

*Bovistina atrogleba* resembles somewhat old weathered plants of *Bovista plumbea* and could easily be mistaken for this species while collecting, however a microscopic examination of the gleba would determine its true status.

One of the most remarkable characters of this plant is the very long capillitial masses of parallel hyphae which extend into the center of the sporocarp, resembling in this respect the capillitia of

certain *Geasters*. These hyphae are agglutinated into a compact mass for about  $\frac{2}{3}$  of their length from point of attachment and are held so firmly together that the endoperidium can be peeled from the gleba leaving it a naked ball of capillitial threads and entangled spores. The agglutinating substance apparently is the disintegrated, amorphous remains of the hymenial tissues.

#### ACKNOWLEDGMENTS

The writers wish to make grateful acknowledgments to Mr. John A. Stevenson for helpful suggestions; to Mr. M. L. F. Foubert for making the photograph for the figures; to Miss Edith K. Cash for preparing the Latin diagnoses; and to Dr. Lee Bonar, Mrs. Vera Miller and Miss Elizabeth E. Morse, of the University of California for many helpful criticisms.

## A NEW SPECIES OF ACHLYA FROM COSTA RICA

FRED T. WOLF

(WITH 13 FIGURES)

Within the past several years, a considerable number of soil samples from various localities have been examined by the writer for the presence of aquatic fungi. Through the kindness of Professor Rafael Lucas Rodriguez, of the Liceo de Costa Rica, a number of collections of soil from the vicinity of San José, C. R., were secured for study. The isolation of *Allomyces arbuscula* from four of these collections has already been reported elsewhere (Wolf, 1941). In addition to *Allomyces*, there was found in two of these collections of soil from Costa Rica an interesting species of *Achlya* which is apparently not identical with any member of this genus hitherto described, and for which the following name is proposed:

### *Achlya Rodrigueziana* sp. nov.

Growth on hemp seed rather dense, reaching a diameter of about 2–2.5 cm. Main hyphae about 40–50  $\mu$  in width at the base. Sporangia abundant, renewed by cymose branching from below. Zoöspores on discharge encysting to form a hollow sphere at the mouth of the sporangium; encysted zoöspores about 10  $\mu$  in diameter. Gemmae fairly abundant, rod-shaped, formed by segmentation of the hyphae. Plant homothallic. Oögonia spherical, abundant in older cultures, 30–50  $\mu$ , averaging 42  $\mu$  in diameter, borne on short lateral stalks from the main hyphae; wall of the oögonium smooth, hyaline, unpitted. Oöspores 1–4 in an oögonium; about 50 per cent of the oögonia with a single oöspore, 40 per cent with two oöspores, 10 per cent with 3 oöspores; four oöspores very rare. Oöspores 20–30  $\mu$  in diameter, averaging 27  $\mu$ , at maturity eccentric, with a single large oil droplet; oöspore wall smooth, thick. Antheridia almost invariably declinuous in origin, very rarely androgynous; antheridial hyphae very slender and branching. Antheridia on a majority of the oögonia, 1–3 when present, rather

long and tubular, irregularly swollen; antheridial tubes visible. Oöspores in oögonia lacking antheridia maturing parthenogenetically. Type locality; Rio Maria Aguila, San José, C. R.

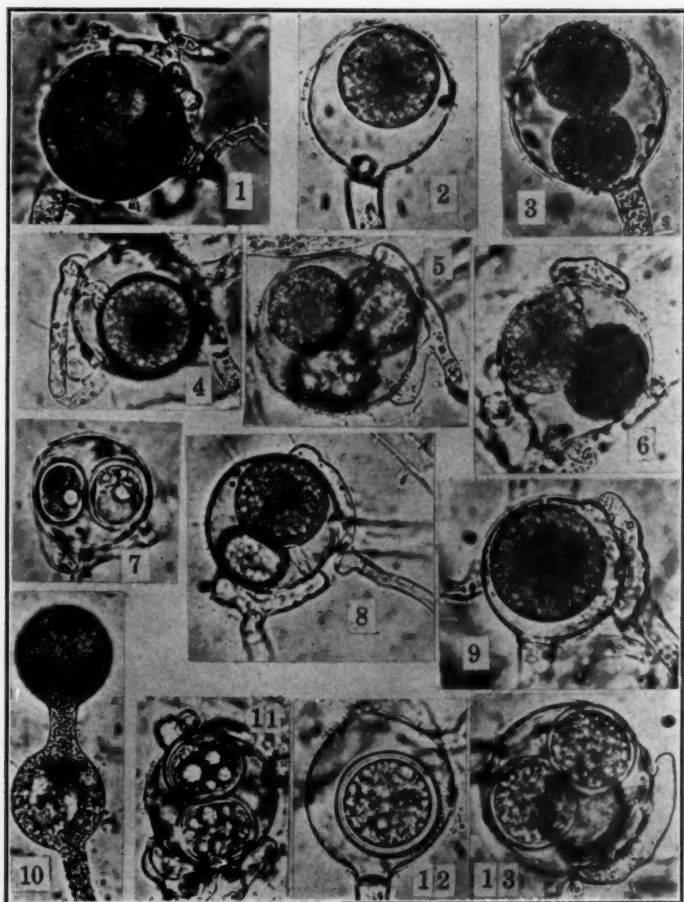
Myceliis in semine *Cannabis sativae* densis, quandoque usque 2.0–2.5 cm. lat.; hyphis primariis basi 40–50  $\mu$  diam.; sporangiis copiosis, et e basi proliferantibus et tunc cymosis; zoosporiis apice dehiscentibus et in sphaerula dispositis; sporis hibernantibus 10  $\mu$  diam. Gemmis plus minusve copiose evolutis, cylindraceis, ex articulis hypharum efformantibus. Plantae homothallicae. Oogoniis globosis, ad ultimum numerosis, 30–50  $\mu$  plerumque 42  $\mu$  diam., in ramulis brevibus et lateralibus insidentibus; tunica oogoniorum hyalina, non-punctulata et omnio levi; oosporis 1–4 in quoque oogonio nascentibus, plerumque singulis vel binis, raro ternatis vel quaternis, 20–30  $\mu$  plerumque 27  $\mu$  diam., maturitate guttulis oleosis variae magnitudinis excentrice coadunatis; episporio levi, crasso; antheridiis praesentibus vel interdum deficientibus, origine diclinis raro androgenis, hyphis antheridiorum longis gracilibus, ramosis, tubulosis, irregulariter bullatis, 1–3 pro quoque oogonio; tubulis antheridiorum visis. Oosporis interdum parthenogeneticis. Hab. ad terram humosam, Rio Maria Aguila, San Jose, C. R.

As has been mentioned above, this organism was isolated from two separate collections of soil; the first taken from the bank of the Rio Maria Aguila, near San José, C. R., on Nov. 18, 1939, and the second from the bank of Cucubres Creek, south of Desamparados, C. R., on Jan. 20, 1940.

Preserved material of this species has been deposited in the Farlow Herbarium of Harvard University.

According to the classification of the genus *Achlya* proposed by Coker (1923), this new species belongs to the "Prolifera group" of the subgenus *Euachlya*, by virtue of the normal behavior of its zoöspores in forming a hollow sphere upon discharge from the zoösporangium, the eccentric nature of the mature oöspore, and the predominantly diclinous origin of the antheridia.

The consistent production of but 1 or 2 oöspores within an oögonium is one of the most distinctive features of *A. Rodrigueziana*. In regard to this character, the Costa Rican species resembles *A. Orion* and *A. apiculata*, in which the antheridia, however, are androgynous for the most part. Similarly, the form described from Czechoslovakia by Cejp (1934) as *A. Hähneliana* is characterized by oögonia with a single egg, and by mostly androgynous antheridia. Among other species with smooth walled oögonia and single oöspores, *A. caroliniana*, *A. abortiva*, and *Isoachlya unisporea* lack antheridia entirely.

FIGS. 1-13. *Achlya Rodrigueziana*.

*A. Rodrigueziana* is obviously not identical with any of the species listed by Coker and Matthews (1937); the combination of such characters as the small size of the oögonia, the small number of oöspores, and the declinous origin of the antheridia warranting its description as new. The possibility of its relationship with any of the heterothallic *Achlyas* would appear to be ruled out by the pres-

ence of an occasional androgynous antheridium. The details of the sexual organs may be seen from the accompanying photographs (FIG. 1-13).

An interesting peculiarity of *A. Rodrigueziana*, which has also been recorded in several other members of the genus, is the proliferation of a young oogonium, in the absence of antheridia, to form a second oogonium (FIG. 10). Due to the smooth hyaline nature of the oogonial wall and the fact that there are few eggs which do not entirely fill the oogonium, the antheridial tubes are easily observed. The presence of empty antheridia on certain of the older oogonia offers evidence for the presumption that fertilization probably occurs, while the eggs of other oogonia in the same culture may mature parthenogenetically, when antheridia are absent.

It is probable that this species is normally aquatic rather than terrestrial in nature, as the material from which it was isolated consisted of mud from creek banks at or near the water line, collected in a moist condition, and allowed to become air dry. Further studies using this method of collection may bring to light additional species of the water molds, as well as contribute to our meager knowledge concerning the ecology of these forms as they occur in nature.

A portion of the work herein reported was carried out during the tenure of a National Research Fellowship in Botany at Harvard University under the direction of Dr. Wm. H. Weston, Jr., to whom the writer is indebted for many helpful suggestions. The writer also wishes to express his most sincere appreciation to Mr. A. E. Prince for assistance in the preparation of the microphotographs and to Dr. F. A. Wolf for the preparation of the Latin diagnosis.

VANDERBILT UNIVERSITY,  
NASHVILLE, TENN.

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#### EXPLANATION OF FIGURES

All figures are of *Achlya Rodrigueziana*. The microphotographs were taken with a Leica camera using a 12.5 X ocular and a 100 X oil immersion objective. Magnification as here reproduced, 525 X. FIG. 1, young oogonium, surrounded by antheridial branches; 2-3, older oogonia with eggs; note absence of antheridia; 4, oogonium and egg; note antheridium and antheridial tube to the left; 5, oogonium with 3 eggs and branching antheridium; note antheridial tube below; 6, oogonium with 2 eggs; 7, oogonium with 2 mature oöspores; note eccentric oil droplets and heavy oöspore wall; 8, oogonium with 2 declinous antheridia; note antheridial tube below; 9, oogonium with a single large egg; 10, proliferation of oogonium to form a second oogonium in the absence of antheridia; 11, oogonium with 2 nearly mature oöspores; note the numerous oil droplets in the process of coalescence; 12, oogonium with a single thick-walled immature oöspore; 13, oogonium with 3 thick-walled immature oöspores.

## SOME FLORIDA NOVELTIES

W. A. MURRILL

The specimens cited in this paper were all collected in or near Gainesville and are permanently deposited in the Herbarium of the Florida Agricultural Experiment Station.

### *Stropharia cyanescens* sp. nov.

Pileo 12 cm. lato, umbonato, fulvo, vulnerato cyanescens; sporis ellipsoideis,  $13-15 \times 8 \mu$ ; stipite albo,  $5-7 \times 1-2$  cm.; annulo amplo, albo, persistente.

Hymenophore becoming cyaneous at any point, without or within, where wounded; pileus conic to convex with conic umbo, at length expanded-umbonate or slightly depressed without umbo, closely gregarious or somewhat cespitose, reaching 12 cm. broad; surface slightly viscid at first with a few scattered, white, floccose scales, becoming dry, glabrous and shining, uniformly fulvous when young, remaining fulvous on the umbo but changing to ochroleucous and creameous in older pilei; margin even, entire, not appendiculate; context white, without odor, taste at first strongly farinaceous, at length somewhat bitter and astringent; lamellae broad, adnate, becoming ventricose, unequal, medium close to subdistant, entire to undulate, watery-white to umbrinous or purplish-brown; spores ellipsoid, smooth, opaque, dark purplish-brown under the microscope, about  $13-15 \times 8 \mu$ ; cystidia none; stipe tapering upward, white or creameous, fibrillose or slightly squamulose below the annulus, hollow,  $5-7 \times 1-2$  cm.; veil ample, white, forming a superior, simple, fixed, persistent, conspicuous ring.

Type collected by W. A. Murrill on a pile of sawdust from a stable at Gainesville, Fla., April 15, 1938 (No. F16209). A very handsome and characteristic species having certain points in common with *S. distans* and *S. depilata*. At first sight one may be reminded of *Agaricus arvensis* unless he happens to notice the conic umbo and adnate gills.

***Stropharia subumbonatescens* sp. nov.**

Pileo 2.5-5 cm. lato, melleo vel isabellino; sporis ellipsoideis,  $11 \times 6.5 \mu$ ; stipite albo, 6-10 cm. longo; annulo non persistente.

Pileus conic-convex to expanded-umbonate, gregarious, 2.5-5 cm. broad; surface smooth, glabrous, slightly viscid, uniformly melleous or isabelline, umbo conic, margin even, entire; lamellae adnate, broad, distant, uneven, soon colored by the spores, edges entire, whitish; spores ellipsoid, smooth, purplish-brown, about  $11 \times 6.5 \mu$ ; stipe long and slender, slightly tapering upward, smooth, subglabrous, white or pallid, 6-10 cm. long, 2-3 mm. thick; veil slight, whitish, evanescent.

Type collected by W. A. Murrill in sandy soil on a road through pines at Gainesville, Fla., February 24, 1929 (No. *F10095*). Near *S. umbonatescens* Peck.

***Gymnopilus amarissimus* sp. nov.**

Pileo 3-4 cm. lato, ferrugineo-fulvo, carne amara; sporis ellipsoideis,  $7-10 \times 4-6 \mu$ ; stipite pallido, 4 cm. longo.

Pileus convex to subexpanded, not at all umbonate, gregarious or scattered, reaching 3-4 cm. broad; surface smooth, glabrous, slightly viscid, at length shining, uniformly ferruginous-fulvous, margin even, entire, inflexed when young; context thin, pale-yellow, darkening when bruised, without odor but at once exceedingly bitter; lamellae sinuate with decurrent tooth, broad, crowded, inserted, pale-yellow to ferruginous, entire; spores ellipsoid, smooth, pale ochraceous,  $7-10 \times 4-6 \mu$ ; cystidia none; stipe equal or tapering upward, smooth, soon glabrous, solid, whitish to creameous, staining ferruginous where bruised, darkening with age, about 4 cm. long and 4 mm. thick; veil fibrillose, very slight, soon vanishing.

Type collected by W. A. Murrill on a dead pine trunk in a low hammock at Magnesia Springs, Alachua Co., Florida, April 12, 1938 (No. *F16206*). A very attractive species, suggesting *Hypholoma perplexum* Peck in its younger stages.

***Gymnopilus praeffloccosus* sp. nov.**

Pileo 2-3 cm. lato, aurantiaco, floccoso; lamellis adnatis; sporis ellipsoideis,  $6-8 \times 4-5 \mu$ ; stipite bulboso, pallido, 4 cm. longo.

Pileus convex to subexpanded, not at all umbonate, solitary, 2-3 cm. broad; surface dry, regular, orange to yellow, uniformly and

densely clothed with large conic floccose warts, which have dark, hardened points at the disk; margin incurved, even, entire; context firm, pale yellow, unchanging, odor none, taste slightly astringent; lamellae squarely adnate, many times inserted, rather narrow, crowded, entire, pallid with a yellowish tint, becoming pale ferruginous; spores ellipsoid, smooth, ferruginous, 1-2-guttulate;  $6-8 \times 4-5 \mu$ ; stipe slightly tapering upward from a distinctly bulbous base, fibrillose to subglabrous, nearly smooth, pallid with a creamy tint, 4 cm. long, 7-8 mm. thick, bulb 1 cm. broad and high; veil slight but forming a very narrow, apical, yellowish, membranous, fixed, subsistent annulus.

Type collected by W. A. Murrill on a much-decayed sweet gum log at Newnan's Lake, Alachua Co., Florida, May 1, 1938 (No. F15620). A very striking and beautiful species suggesting *G. Nashii* Murr. but not cespitose. The warts are 2 mm. high and the spore print fulvous. Some species of *Pholiota* are warted but none seem to fit our plant, which is a true *Gymnopilus* in spite of its slight annulus.

***Inocybe alachuana* sp. nov.**

Pileo 2-3 cm. lato, albo, subglabro, sapore farinaceo; cystidiis  $35-40 \mu$ , sporis angulatis,  $6-8 \times 4-5 \mu$ ; stipite albo, circiter 2.5 cm. longo.

Pileus conic to expanded-umbonate, at times depressed and splitting with age; gregarious, 2-3 cm. broad; surface slightly viscid, subshining, subglabrous, somewhat radially rimose in old specimens, uniformly white or whitish, margin at first incurved, even, entire; context white, thin, with distinctly farinaceous odor and taste; lamellae sinuate, broad, several times inserted, crowded, entire, pallid to rosy and finally brownish-discolored; cystidia fusoid, hyaline, scanty, projecting  $35-45 \mu$ ; spores angular, irregular, subvoid in outline, uniguttulate, ferruginous,  $6-8 \times 4-5 \mu$ ; stipe equal, smooth, glabrous, white, solid, about  $2.5 \times 0.3$  cm.

Type collected by W. A. Murrill in moist open soil at the edge of a pond cypress swamp on the Palatka Road about twelve miles east of Gainesville, Florida, April 10, 1938 (No. F16201). Found in quantity in all stages of development. An attractive white species near *I. paludinella* (Peck) Sacc.

***Inocybe prae-echinulata* sp. nov.**

Pileo 2 cm. lato, fibrilloso-squamuloso, umbrino; lamellis adnatis; sporis echinulatis,  $8 \times 5 \mu$ , cystidiis  $30 \times 10 \mu$ ; stipite umbrino, 3 cm. longo.

Pileus conic to expanded-umbonate, gregarious, about 2 cm. broad, rarely 3 cm.; surface dry, densely fibrillose-squamulose, uniformly umbrinous, margin even, entire; context thin, pallid, taste slightly farinaceous, odor none; lamellae adnate, broad, ventricose, medium distant, inserted, pallid to brownish; edges white, entire; spores ellipsoid in outline, pale ferruginous, very echinulate, about  $8 \times 5 \mu$ ; cystidia abundant, subventricose, hyaline, about  $30 \times 10 \mu$ ; stipe subequal, solid, subglabrous, concolorous or darker, about 3 cm. long and 2-3 mm. thick.

Type collected by W. A. Murrill in low ground by the roadside east of the Flying Field at Gainesville, Florida, April 3, 1938 (No. F16189). The spores appear under the microscope like short miniature cockleburrs.

***Inocybe subeutheloides* sp. nov.**

Pileo 2.5 cm. lato, hispido-squamuloso, isabellino; cystidiis  $60 \times 15 \mu$ , sporis ellipsoideis, glabris,  $9 \times 4.5 \mu$ ; stipite albo, 2.5-3 cm. longo.

Pileus convex to expanded-umbonate, at length depressed-umbonate, gregarious, 2.5 cm. broad; surface dry, finely hispid-squamulose, slightly rimose-lacerate with age, isabelline, the umbo small, conic, subfuliginous, margin at length splitting; context thin, firm, white; lamellae sinuate-adnexed, broad, ventricose, medium distant, uneven, whitish-fimbriate on the edges, pallid to ferruginous; cystidia large, hyaline, scanty, shaped like a milk bottle, about  $15 \mu$  in diameter and projecting about  $60 \mu$ ; spores ellipsoid, smooth, uniguttulate, ochraceous, about  $9 \times 4.5 \mu$ ; stipe short, equal, subglabrous, smooth, white, 2.5-3 cm. long and 3-4 mm. thick.

Type collected by W. A. Murrill on a bank in oak-pine woods at Gainesville, Florida, February 6, 1938 (No. F16062). Related to *I. eutheloides* (Peck) C. H. K.

***Inocybe praenodulosa* sp. nov.**

Pileo 5-12 mm. lato, fibrilloso-squamuloso, umbrino, carne amara et farinacea; cystidiis  $75 \times 15 \mu$ , sporis papillosis,  $8 \times 6 \mu$ ; stipite albo, 2-3 cm. longo.

Pileus conic to expanded-umbonate, gregarious to subcespitose, 5-12 mm. broad; surface dry, fibrillose-squamulose, becoming somewhat lacerate, uniformly umbrinous; context thin, white, bitter-farinaceous; lamellae adnate, broad, crowded, inserted, en-

tire, pallid to fulvous; cystidia abundant, hyaline, subventricose above a short, slender pedicel, apex obtuse, about  $75 \times 15 \mu$ ; spores pale ferruginous, prominently adorned with long, obtuse papillae, about  $8 \times 6 \mu$ ; stipe slender, equal, smooth, pruinose, white, 2-3 cm. long and 1-1.5 mm. thick.

Type collected by W. A. Murrill in damp soil by the roadside at Hatchet Creek, east of Gainesville, Florida, April 7, 1938 (No. F16194). A small but well-marked species.

***Inocybe subnodulosa* sp. nov.**

Pileo 2-2.5 cm. lato, innato-fibrilloso, pallide umbrino, cystidiis subventricosis,  $60 \times 15 \mu$ , sporis angulatis-nodulosis,  $6-9 \times 5-6 \mu$ ; stipite bulboso, umbrino, 3 cm. longo.

Pileus conic-convex to expanded-umbonate, gregarious, 2-2.5 cm. broad; surface dry, rimose, innate-fibrillose, rather uneven, pale umbrinous, umbrinous on the prominent subconic umbo, margin usually splitting with age; context thin, white, taste somewhat mawkish, odor none; lamellae adnexed, rounded behind, rather broad, crowded, unequal, entire, pallid to discolored; cystidia subventricose with blunt apex and tapering pedicel, hyaline, abundant, about  $60 \times 15 \mu$ ; spores globose to ellipsoid in outline, coarsely angular-nodulose, ferruginous,  $6-9 \times 5-6 \mu$ ; stipe tapering upward from a prominent emarginate ovoid bulb, subconcolorous, subglabrous, about 3-4 cm. long and 2-4 mm. thick.

Type collected by W. A. Murrill on low ground under slash pines on the Palatka Road about twelve miles east of Gainesville, Florida, April 10, 1938 (No. F16076). Also collected by the author in mixed woods at Gainesville, December 1, 1926 (No. F10082). Related to *I. nodulosa* C. H. K.

***Inocybe subprominens* sp. nov.**

Pileo 5 cm. lato, rimoso-fibrilloso, fulvo-isabellino; cystidiis magnis, sporis angulatis,  $7-9 \times 4-5 \mu$ ; stipite albo, 5.5 cm. longo.

Pileus conic-campanulate to expanded-umbonate, solitary, 5 cm. broad; surface dry, rimose-fibrillose, fulvous-isabelline, fulvous-castaneous on the prominent conic umbo, margin splitting with age; context thin, white, taste nutty, odor none; lamellae adnexed, broad, ventricose, rather distant, entire, pallid to brownish; cystidia large, flask-shaped, hyaline, abundant; spores angular, ferruginous, 7-9

$\times 4-5 \mu$ ; stipe tapering upward, smooth, flocculent above, white, 5.5 cm. long and about 6 mm. thick at the middle.

Type collected by W. A. Murrill in low ground at Gainesville, Florida, April 9, 1938 (No. 16128). Also collected by the author under evergreen oaks at Gainesville, September 24, 25, 1932 (Nos. 10080, 10078). Near *I. radiata* Peck and *I. prominens* C. H. K.

**Naucoria collybiiformis** sp. nov.

Pileo 1.5-2 cm. lato, albo, glabro, sapore grato; sporis ellipsoideis,  $11-13 \times 6-7 \mu$ ; stipite albo, 1.5-2 cm. longo.

Pileus convex to subexpanded, broadly umbonate, irregular, closely cespitose, 1.5-2 cm. broad; surface glabrous, uneven, not at all viscid, hygrophanous to milk-white, margin incurved when young, remaining hygrophanous for some time, repand, not striate; context thin, white, unchanging, fragrant like anise, taste mild; lamellae adnate, broad, unequal, medium distant, watery-white, entire, very slow to become discolored; spores ellipsoid, smooth, not guttulate, ferruginous under the microscope, fuscous in mass,  $11-13 \times 6-7 \mu$ ; cystidia none; stipe cartilaginous, hollow, subequal, soon glabrous, watery-white to white, 1.5-2 cm. long and 3-4 mm. thick; veil entirely lacking.

Type collected by W. A. Murrill in a sawdust pile at Gainesville, Florida, April 15, 1938 (No. F16207). Peculiar in having the appearance of a *Collybia* but showing ferruginous spores under the microscope. It is our only white species.

**Tubaria subcrenulata** sp. nov.

Pileo 1-2 cm. lato, roseo-isabellino, flocculoso; sporis ovoideis,  $7-8 \times 4-5 \mu$ ; stipite roseo-isabellino, 2.5-3 cm. longo.

Pileus convex to slightly depressed or subumbilicate, gregarious or cespitose, 1-2 cm. broad; surface dull rosy-isabelline, somewhat rugulose, finely floccose with whitish scales from the raised cuticle, plicate-sulcate with age, margin concolorous, even, entire; context very thin, without taste or odor; lamellae short-decurrent or adnate with decurrent tooth, rather distant, broad, inserted, entire, fulvous with age; spores ovoid, smooth, uniguttulate, pale ochraceous,  $7-8 \times 4-5 \mu$ ; cystidia none; stipe slender, very slightly enlarged upward, smooth, shining, pale rosy-isabelline, whitish-mycelioid at the base, subfibrillose to glabrous, striatulate above, cartilaginous,

2.5–3 cm. long, 1–2 mm. thick; veil forming at times a slight apical annulus.

Type collected by W. A. Murrill in humus in oak woods at Gainesville, Florida, November 12, 1932 (No. 10076). Also collected by the author at Gainesville, Fla., November 8, 1932 (No. 10077); and in wet soil in a low hammock, March 6, 1938 (No. 16074). It is closely related to *T. crenulata*.

***Nolanea subavellanea* sp. nov.**

Pileo 3.5 cm. lato, umbonato, squamuloso, avellaneo, sapore farinaceo; lamellis adnexis, sporis angulatis,  $10-12 \times 6 \mu$ ; stipite pallido, glabro, 5–8 cm. longo.

Pileus conic to expanded with conic umbo, slightly depressed with age, gregarious or scattered, reaching 3.5 cm. broad; surface smooth, squamulose, opaque, avellaneous, fuliginous on the umbo, margin even and entire, often splitting with age and becoming striatulate over the gills; context very thin, pallid, without odor until dried, taste strongly farinaceous; lamellae adnexed, ventricose, broad, inserted, rather distant, entire, pallid to pale pink; spores very irregular, angular, pink,  $10-12 \times 6 \mu$ ; stipe long, slender, smooth, glabrous, shining, hollow, very slightly tapering upward, pallid with a faint yellowish tint, twisted at times, finely striatulate, whitish-mycelioid at the base, 5–8 cm. long, 2.5–5 cm. thick.

Type collected by W. A. Murrill in soil in a low hammock near Gainesville, Florida, March 5, 1938 (No. F16075). Also collected twice in woods at Gainesville by E. West and W. A. Murrill on November 8, 1932 (Nos. F10016, F10022). Suggesting my *N. avellanea* but squamulose. After drying in the sun a strong, persistent, rancid odor developed.

***Russula subpusilla* sp. nov.**

Pileo convexo ad depresso, 3–4 cm. lato, glabro, roseo vel roseo-cremeo; carne alba, grata; sporis subglobosis, flavis, echinulatis,  $6-8 \mu$ ; stipite albo,  $3-5 \times 1$  cm.

Pileus convex to depressed, solitary or gregarious, 3–4 cm. broad; surface slightly viscid when moist, smooth, glabrous, roseous or roseous-cremeous, cuticle separable, margin scarcely striate; context white, unchanging, sweet or very slightly astringent; lamellae white to yellow, adnexed, narrow, close, entire, equal, very few

forking; spores subglobose, distinctly echinulate, yellow,  $6-8\mu$ ; cystidia none; stipe equal, white, smooth, glabrous, about  $3-5 \times 1$  cm.

Type collected by George F. Weber on the ground under an oak at Gainesville, Fla., July 1, 1926 (F9512). Also collected by West & Murrill in oak woods at Gainesville, Nov. 9, 1932 (F9554); and by W. A. Murrill on a lawn under an oak in Gainesville, May 10, 1938 (F9522). *Russula pusilla* Peck is red, not pink, and grows under pines rather than oaks.

***Lepiota floridana* sp. nov.**

Pileo convexo, 3-5 cm. lato, squamuloso, cremeo, disco castaneo; sporis  $6 \times 5\mu$ ; stipite albo, castanescente, 4-5 cm. longo, abrupte bulboso; annulo amplo, medio.

Pileus convex to subexpanded, not umbonate, gregarious, 3-5 cm. broad; surface dry, squamulose, white with creamy scales, the disk castaneous; margin white, short-striate and almost free of scales in older hymenophores; context firm, white, unchanging, sweet and nutty; lamellae free, remote, rounded behind, narrow, crowded, a few forked and a few inserted, entire, white, unchanged on drying except near the stipe; spores subglobose to broadly ellipsoid, smooth, hyaline, about  $6 \times 5\mu$ ; cystidia none; stipe tapering upward, smooth, glabrous, white, becoming partly or wholly castaneous on drying,  $4-5 \times 0.4-0.8$  cm.; bulb abrupt, large, about  $1.5 \times 1.3$  cm.; annulus ample, membranous, median, fixed, persistent, single, white above and castaneous below.

Type collected by W. A. Murrill in rich, exposed, grassy soil in Gainesville, Fla., May 13, 1938 (No. F16250). The abrupt bulb suggests *L. abruptulba* Murr., described from Cuba. The stipe assumes on drying the color found on the disk of fresh plants.

***Venenarius subvirginianus* sp. nov.**

Pileo 2 cm. lato, glabro, avellaneo, striato; sporis  $10-12 \times 8-9\mu$ , cystidiis clavatis, obtusis,  $20\mu$ ; stipite albo, 4 cm. longo; annulo parvo, volva cupuliformi, parva, alba.

Pileus convex to plane, not umbonate, solitary, 2 cm. broad; surface somewhat viscid, glabrous, without volval patches, uniformly avellaneous, margin entire, concolorous, conspicuously striate halfway to the center; context very thin, white, without odor; lamellae adnexed, of medium width and distance, not forked, twice inserted,

slightly ventricose, entire, white; spores subglobose or broadly ellipsoid, smooth, hyaline, uniguttulate,  $10-12 \times 8-9 \mu$ ; cystidia large, clavate, inflated, obtuse, thin-walled, hyaline, scanty, projecting about  $20 \mu$ ; stipe very slightly tapering upward from a small bulb, dry, smooth, minutely pubescent under a lens, milk-white, unchanging, 4 cm. long, 3.5-4 mm. thick; annulus median, fixed, small, simple, persistent, white; volva narrow, lobed, the limb free, white.

Type collected by W. A. Murrill on moist black soil in a low hammock near Gainesville, Florida, March 27, 1938 (No. *F16134*). Suggesting *V. virginianus* but differing in color and in certain other characteristics. The cystidia nestle among the basidia like laterally compressed balloons.

#### NEW COMBINATIONS

For those using Saccardo's nomenclature the following new combinations are made:

*Gymnopilus amarissimus* = **Flammula amarissima**

*Gymnopilus praefloccosus* = **Flammula praefloccosa**

*Venenarius subvirginianus* = **Amanita subvirginiana**

GAINESVILLE, FLORIDA

## OBSERVATIONS ON MINDENIELLA SPINOSPORA<sup>1</sup>

F. K. SPARROW, JR., AND V. M. CUTTER, JR.

(WITH 1 FIGURE)

In 1927, Dr. B. B. Kanouse (1) reported the finding on submerged rosaceous fruits in the vicinity of Ann Arbor, Michigan, of an extremely interesting aquatic Phycomycete, which she described as *Mindeniella spinospora*, a new genus and species of the Blastocladales. Since then, if one may judge from reports in the literature, the fungus has apparently remained unobserved.

In general habit it closely resembled a species of *Blastocladia*, particularly those forms of *B. Pringsheimii* in which the apex of the basal cell is unbranched and strongly expanded. Furthermore, like *Blastocladia*, it occurred in pustules on the substrate, mixed with other water molds such as *Rhipidium* and *Gonapodya*. It was pointed out at the time, however, by Dr. Kanouse, that her fungus differed markedly from other blastocladaceous organisms in the following respects: the strong cellulose reaction of the walls, the reproductive organs being borne on short pedicels, and in the formation of delicate spines on the resting spores and on certain sporangia. As has been previously pointed out by the senior author (2), the precise relationships of Dr. Kanouse's fungus—combining as it did certain characteristics of both Blastocladales and Leptomitales—could not be ascertained until studies were made of the structure and flagellation of the zoöspores. This was essential, since it is now recognized that among water fungi as among other members of the plant kingdom, parallelisms of body form frequently occur among species of very different orders, which often obscure their true relationships. It was also suggested at the time that *Mindeniella* showed strong affinities with *Araiospora*, a member of the Leptomitales, and indeed, that if the zoöspores were

<sup>1</sup> Paper from Department of Botany, University of Michigan, No. 771, and Department of Botany, Cornell University.

found to be laterally biflagellate, there were strong reasons for including it in this genus. On the other hand, if the zoöspores possessed a single flagellum, the inclusion of *Mindeniella* in the Blastocladales as done by Kanouse, was fully justified. It was evident, then, that the affinities of the fungus depended upon the structure of the zoöspore.

As Dr. Kanouse suggests in her paper, *Mindeniella* is evidently of rare occurrence. Indeed, although the senior author has examined many hundreds of submerged rosaceous fruits from American and European sites in the past decade, he has never heretofore encountered it. During the summer of 1940 the authors were fortunate in obtaining large quantities of *Mindeniella* from a small pool in the courtyard of the Natural Science Building in Ann Arbor, which enabled them to make such a study of the organism as would throw definite light on its precise affinities and relationships to the other water molds. Since the pool in question had long acted as a general dumping ground for various aquatic plants and animals collected in the vicinity of Ann Arbor, the exact place of origin of the fungus was not known. Dr. Kanouse assures us, however, that at no time was her material collected from this pool nor was any *Mindeniella* ever put in it by her. In view of its apparent rarity it is interesting to note that the substrata in our collections were frequently covered with pustules composed, so far as filamentous fungi were concerned, of nothing but *Mindeniella*. It would appear therefore, that, although the fungus may be rather local in its distribution, it may be abundant where it does occur.

The thallus of the plant (FIG. D) resembles *B. Pringsheimii*, consisting of a well-developed basal cell which is anchored in the substrate by a system of branched hold-fasts. The basal cell is predominantly narrowly clavate, rarely cylindrical. In a few cases it may be divided at the apex into two blunt lobes, but nothing approximating the pronounced diverticula found, for example, in certain thalli of *Blastocladia Pringsheimii*, is formed by *Mindeniella*. The basal cell may attain a length of 850  $\mu$ , although in most cases it is not over 500  $\mu$ . Its narrow, proximal part from which the branching, blunt-tipped hold-fast system emerges, is seldom over 30-40  $\mu$  in diameter, whereas the usually expanded and rounded dome-like apex may be 200  $\mu$  wide. The colorless wall is stout and

on the outer surface of older plants there may frequently be found bits of exfoliated material. A strong cellulose reaction is apparent when chlor-iodide of zinc solution is applied.

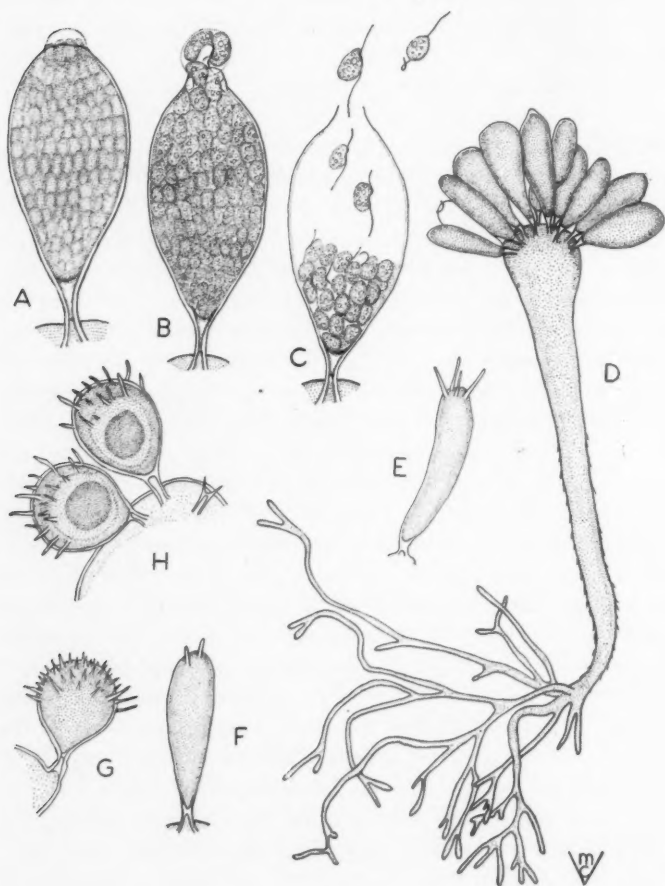


FIG. 1. *Mindeniella spinospora*.

Zoosporangia are formed for the most part over the surface of the dome-like, expanded, distal part of the basal cell. In certain plants, particularly those in old pustules, they may also arise lower

down on the trunk. As in *Rhipidium* and *Araiospora*, the zoösporangia, which may be 1-12 or more in number, are borne on short, narrow thick-walled pedicels, here, however, arising directly from the basal cell. They are usually narrowly and symmetrically clavate or ovate (FIG. A), and occasionally slightly constricted in the mid-region. At maturity a prominent apical discharge papilla is formed. The sporangia are somewhat variable in size, fully mature specimens varying from  $125 \times 33 \mu$  to  $250 \mu$  long by  $50 \mu$  in greatest diameter. A peculiar feature of *Mindeniella*, found also in the genus *Araiospora*, is the formation of two types of sporangia—spiny and smooth-walled. In contrast to most species of *Araiospora*, however, no differences in shape or size are apparent between sporangia of the two types. The spiny sporangia bear 1-8 erect spines which are irregularly disposed around the discharge papilla (FIGS. E, F), whereas, of course these are lacking in the more common smooth-walled type.

The zoöspores are fully formed within the sporangia. At the moment of discharge the apical papilla suddenly expands to form a delicate vesicle which surrounds the first of the emerging zoöspores (FIGS. A-C). This structure soon disappears, however, after which the great majority of swimmers emerge individually at a rapid rate. They swim away at once from the vicinity of the sporangial orifice. The zoöspore (FIG. C) is of the "secondary" type, commonly described as "reniform," "bean-shaped," or "grape-seed-like." It is  $8-15 \mu$  long by  $6-10 \mu$  wide, the majority being about  $8 \times 12 \mu$ . The contents are characterized by the possession of numerous small refractive globules which lend to the spore an appearance strikingly similar to that exhibited by the zoöspores of *Rhipidium*. A slightly anteriorly disposed vacuole is also usually found. There are two oppositely directed flagella. Definite evidence for at least one repeated emergence of the zoöspore was observed.

A few, probably immature, resting spores were found, but, in spite of intensive and prolonged search, not in sufficient numbers to add anything new to the account of these structures already given by Kanouse. In our material they occurred on thalli with the zoösporangia, each being formed in a nearly spherical container,  $56-59 \mu$  in diameter, with a thickened wall. The upper  $\frac{1}{3}$

to  $\frac{1}{2}$  of the outer surface of the container bore numerous slender, very sharp-pointed, colorless, solid spines, 15–25  $\mu$  in length. In the dense contents of the spore itself, there could be observed a large central, brownish oil globule. Whether or not the material between the periphery of the globule and the inner wall of spiny container was cytoplasm or wall material could not be determined. During the latter part of the summer numerous empty spiny containers were found (FIG. G). No fracturing of the wall could be detected and the method whereby the resting spores had slipped from their case—if such an interpretation is justified—is not known.

No antheridial structures were found and, as Kanouse pointed out, the spore is apogamously developed.

#### DISCUSSION

*Mindeniella spinospora* is unquestionably distinct among the aquatic Phycomycetes and well merits the generic individuality given it by Kanouse. While in general habit and mode of life it resembles *Blastocladia*, its pedicellate reproductive organs, cellulose walls, and particularly its biflagellate zoöspores, show it to belong to the Leptomitales. Of the members of this order, *Mindeniella* in one or another characteristic, shows distinct affinities with two genera, *Rhipidium* and *Araiospora*. In *Rhipidium* the basal cell is similar to that of *Mindeniella*, but strongly expanded distally to form a platform from which hyphal branches or less commonly, the pedicellate zoösporangia arise. The zoöspores of *Rhipidium* bear refractive globules and are formed in sporangia similar in shape but shorter than those of *Mindeniella*. In *Araiospora*, while the basal cell is more cylindrical, two types of zoösporangia are formed, one smooth, the other, as in *Mindeniella*, ornamented with sharp spines. *Mindeniella* differs from both of these genera, however, in the lack of branches arising from the basal cell, in the lack of sexual reproduction, and in the formation of an apogamous resting spore borne in a spiny container.

There can, therefore, be no further doubt that *Mindeniella spinospora* belongs in the Leptomitales rather than in the Blasto-

cladiales, where, because of the remarkable similarity in body form, it was placed by its discoverer.

BOTANY DEPARTMENT,  
UNIVERSITY OF MICHIGAN,  
ANN ARBOR, MICHIGAN  
BOTANY DEPARTMENT,  
CORNELL UNIVERSITY,  
ITHACA, NEW YORK

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#### EXPLANATION OF FIGURES

FIG. 1. All figures were drawn with the aid of the camera lucida from living material. Fig. *D*  $\times 280$ , all others  $\times 600$ . Figures drawn by V. M. Cutter, Jr. *A.* Nearly mature sporangium showing basal pedicel and apical discharge papilla. *B.* Initiation of zoospore discharge. The first emerged zoöspores are surrounded by a delicate quickly evanescent vesicle. *C.* Later stage in discharge. The zoöspores are emerging individually. *D.* Complete plant showing hold-fast system and clavate basal cell on the apex of which the zoösporangia are borne. *E, F.* Spiny zoösporangia. *G.* Empty, spiny container of resting spore. *H.* Two immature resting spores in their spiny containers. Each bears a large brownish globule in its contents.

## NOTES ON THE MYCETOZOA—V

ROBERT HAGELSTEIN

In this paper, I continue the practice of reporting annually the interesting specimens of Mycetozoa added during the year to the collection in the Herbarium of the New York Botanical Garden. Prior to the publication of this series of Notes, the records of the distribution in North America were deficient in many species. Many were said to be rare, or more exactly, rarely collected. The Notes have shown that many species formerly regarded as rare are not uncommon, and are well distributed geographically. The results are due to the efforts of experienced collectors, who take into consideration the habitat, the time of appearance, and the local natural conditions applying to the area of their collecting activities.

Much depends upon the seasons for the prolific development of the fruiting bodies. In the tropics, where there is no alternation of winters and summers, they are not so abundant. In lowlands of the temperate zones, like Long Island where I reside, the winters are often open with little snow and frequent periods of warm weather. During such warm spells, if continued, the plasmodium revives, vegetates, and produces fruit, the latter while forming often meeting sudden changes to freezing temperatures, which destroy it so that it is incapable of further reproduction of the species. The best conditions are found in mountainous regions at higher altitudes, or in other territory where the winters are continuous. Here the sclerotium does not revive until the spring, and the resulting fruit does not meet the additional hazards of the winter fruitings. Subject to the local conditions of moisture and food supply, it will be found that following a cold, closed winter there will be an abundant crop of fruiting bodies at some time during the season, depending more or less on the local weather conditions. At such times the less often collected species may be looked for.

We were unable to attend the Foray of the Mycological Society of America held in Maine, in August. Our entire time was therefore devoted to Pike County, Pennsylvania, which was kept under

close observation from late in May to the middle of October by frequent visits of long or short duration. The winter conditions had been as outlined, and the abundant crops appeared in July and October, although large developments were found as early as the end of May. As was expected, many unusual species were found, and five of them for the first time in our collecting experience. There were disappointments and thrills in between, and the greatest thrill came in October when the log later described under *Coloderma oculatum* was found. In addition to the species noted there were four others, *Diderma radiatum* (L.) Morg., *Licea flexuosa* Pers., *Trichia Botrytis* (Gmel.) Pers., and *Trichia decipiens* (Pers.) Macbr., a total of eight on one log, and all in a state of perfect maturity. A few feet away, on another log, was a development of *Cribraria rufa* (Roth) Rost.

Many interesting species are found on dead, coniferous wood such as pine, hemlock, spruce, etc. The best logs are the larger ones, a foot or more in diameter, and they should be in the state of decay with lichens and liverworts growing on them. Mosses are also present usually, and they conceal many sporangia so that careful search should be made. When a good form is found, the area should be worked thoroughly for logs with other developments, as the Mycetoza have the habit of appearing in many fruitings at the same time. Plenty of material should be taken as the form may not be found again for years. Undoubtedly the same species will appear again, but it may be in another place, and the collector cannot cover everything. It is surprising how little area is actually covered in a season. Taken together, foot by foot, it amounts to only a few acres.

The species of *Amaurochaete* and *Brefeldia* must be rare in eastern North America. We have found *A. fuliginosa* (Sow.) Macbr. and *B. maxima* (Fries) Rost. on Long Island, but not elsewhere, and they have not come here from other students in recent years. Ontario, with its ardent students who have uncovered so many good things, may bring them forth again.

Collections herein reported were all in the year 1940 unless otherwise stated. When no collector's name is given, they were made by Joseph H. Rispaud, John D. Thomas, or me, or working in company.

*ARCYRIA FERRUGINEA* Sauter. A beautiful example of the large phase with spores under  $10\ \mu$  diam. was received from Roy F. Cain of the University of Toronto, and collected by W. R. Watson at Lake Timagami, Ontario, in September 1923. It seems to be rare compared with the small phase having larger spores which we found eight times during the season in Pike County, Pennsylvania, and on many occasions previously. Four specimens of the small phase have also come here collected by Eli Davis or W. D. Sutton in different areas of Ontario on different days. Both write that it was not uncommon during the season. The spores in the latter are slightly below  $10\ \mu$  diam. Comparing extremes of the two phases, it might appear that they are separate species, but the material now available here with intermediates justifies the belief that all should be regarded as *A. ferruginea*. N. Y. B. G. Nos. 9426, 9554, 9555, 9556, 9557.

*ARCYRIA STIPATA* (Schw.) List. A fine collection made in Pike County, Pennsylvania, in September, is notable for the distinctness of the spirals on the capillitium. The spirals are not, however, like those of a *Hemitrichia* where they are continuous ridges or thickenings which wind around so that they can be seen on the edges and their number counted. In our specimen the threads of the capillitium are ornamented with warts or spines and short protuberances arranged diagonally across the threads, and it is the intervals between them that appear in the microscope like continuous windings.

*Hemitrichia imperialis* G. List. (Trans. Brit. Myc. Soc. 14: 225-227. 1929) is very much like *A. stipata*, but has true spirals like a *Hemitrichia*. N. Y. B. G. No. 2765.

*COLLODERMA OCULATUM* (Lipp.) G. List. In early October, Mr. Rispaud and Mr. Thomas entered a small, swampy area in Pike County, Pennsylvania, which had not been visited before. Observing a large coniferous log, thickly covered with mosses, lichens, and liverworts, they examined it and found thereon a number of species of Mycetozoa including *Lepidoderma tigrinum* (Schrad.) Rost., *Diderma roanense* (Rex) Macbr., and *Lamproderma columbinum* (Pers.) Rost. On their return in the evening, and while studying the various species from this log under the

microscope, we were surprised to find among them many single, widely separated sporangia of *Colloderma oculatum*. These had formed during the day on the wet base, and were surrounded at the lower part by the gelatinous sheath characteristic of the species. The emerged sporangia were more often of a dull, dark blue color, although occasionally iridescent blue or purplish-brown.

A week later I joined my friends in another visit to the locality, and we took back with us the remaining moss from the log, which gave us abundant material, although as the sporangia are widely separated and often covered by moss, it is difficult to select them. On another log nearby, we found another small development, and in other parts of the area several unusual species were discovered.

The capillitium in the sporangia of *C. oculatum* consists of a persistent, netted mass of hyaline threads attached to the base of the sporangium. The threads are broader below, becoming slender at the tops, and many of them are jointed or segmented. The spores are purplish-gray, distinctly spinulose, and measure about  $12\ \mu$  diam. N. Y. B. G. Nos. 2627, 2741.

COMATRICHA CORNEA G. List. & Cran. Mr. Brooks has sent here two different specimens of a minute *Comatricha* which developed in a moist chamber on wetted wood collected in Geary County, Kansas. They agree in nearly all respects with the description of *Comatricha cornea*, particularly in the character of the translucent stalks which are reddish-brown throughout the greater part of their length, darker at the tops, and yellowish-brown at the bases. They are striated longitudinally, indicating a fibrous structure. The sporangia are small 0.1 to 0.2 mm. diam., and the stalks are 0.3 to 0.5 mm. in length, much longer than described by the authors of the species. The columella and capillitium meet the description even to the small collar at the base of the sporangium. The spores are violet-gray,  $8.5\text{--}9.5\ \mu$  diam., and are marked with spines that can be seen distinctly on the edges, with some of the spores larger and darker than the others.

The species is unknown from North America so far as I know. The translucent, fibrous stalk is the important feature and characteristic. The length of the stalks is unimportant in my opinion, as in nearly all *Comatrichas* we find great variation in the length of

the stalks. Likewise with the stronger marking of the spores. These forms are probably *C. cornea*, and are so regarded. N. Y. B. G. Nos. 9305, 9341.

COMATRICHA ELEGANS (Racib.) List. One of my associates, Leon J. Chabot, is very active in the collection of the Mycetoza while on trips in his automobile throughout Nassau County, New York. On one of the last days in May he found a small fruiting of *C. elegans*, which on closer examination at home was seen to have orange-red spores in mass and also under the lens. This is var. *pallens* G. List. proposed in the 3rd edition of the British Monograph for a phase with reddish-lilac spores, only, in our specimen, the reddish tints are more strongly emphasized. The reddish spores are in the fresh sporangia where the spores are still intact. In the older sporangia where almost all the spores are dispelled, the few remaining have changed in color to the brownish-violet tints of the normal form. There is nothing to indicate that the development is abnormal although it formed in a long period of rain. Differences in spore colors are known in many species. I doubt the spore color in var. *pallens* is important enough to regard it as a constant, definite variety, believing it is caused by adverse conditions prevailing at the time of development. N. Y. B. G. No. 2054.

COMATRICHA NIGRA (Pers.) Schroet. A collection made in Pike County, Pennsylvania, in September, has ellipsoid sporangia 1 mm. in the larger diameter, on long thin stalks, with a total height of 8 mm., an extraordinary size for this species. N. Y. B. G. No. 2720.

COMATRICHA RISPAUDII Hagelstein. Found on five occasions in different areas of Pike County, Pennsylvania, in August. N. Y. B. G. Nos. 2716, 2717, 2718, 2719, 2806.

COMATRICHA RUBENS List. Strange, that this species has such a narrow range of distribution in the American literature. It should be found almost anywhere on leaves if carefully searched for as it is not rare. Specimens are in the Herbarium of the New York Botanical Garden from Maine, Massachusetts, New York, Pennsylvania, Virginia, and Quebec.

*CRIBRARIA CUPREA* Morg. The species has come here collected by Mr. Eli Davis at Komoka, Ontario, in June. It was also found by Mr. Travis E. Brooks in Geary County, Kansas, in July 1937. There seem to be reasons for regarding it as distinct from *Cribraria languescens* Rex, aside from the copper color which has been over emphasized, and is not always pronounced. Color in all the *Cribrarias* is an uncertain character. In the calyculus and nodes, it depends somewhat upon the abundance of the dark, plasmodic granules. In the spores, the color changes with age. *C. cuprea* is much smaller than *C. languescens*; the stalks are firmer; the cup is not so cleanly defined; the net is more irregular; and the nodes are thinner and more flattened. In some of these characters the form will approach *C. languescens* at times, but intermediate forms are common in nearly all *Cribrarias*. N. Y. B. G. Nos. 8327, 9558.

*CRIBRARIA LANGUESCENS* Rex. The species is not reported often from eastern North America, and we have never collected it until this past season, when two gatherings were made in Pike County, Pennsylvania, in August. A similar collection was also made by Mr. Eli Davis at Byron, Ontario, in June. Altogether it is a fine form developing on dryer and firmer wood, and not so scraggy as many of the other *Cribrarias*. N. Y. B. G. Nos. 2710, 2808, 9559, 9560.

*CRIBRARIA LAXA* Hagelstein. Found on two occasions in Pike County, Pennsylvania, in August. Each time a development of *Comatricha Rispaudii* Hagelstein was nearby, and the same association has been noted with earlier collections. Both forms should be searched for on leaves in dryer portions of wet swamps. N. Y. B. G. Nos. 2794, 2802.

*CRIBRARIA RUFA* (Roth) Rost. Pike County, Pennsylvania, furnishes another record for this species where it was found in October on the under side of a rotting log. The specimen is nowhere as handsome as others from the western States, or from Europe, but normal and well matured. The orange color, with the wide meshed net and hardly expanded nodes, are characteristic. A similar collection was made by Mr. Eli Davis at Komoka, Ontario, in September. N. Y. B. G. Nos. 2742, 9561.

*CRIBRARIA SPLENDENS* (Schrad.) Pers. Found in Pike County, Pennsylvania, in September. The species apparently forms small plasmodia with subsequent few sporangia, and in very wet areas. That has been the case with all our collections. N. Y. B. G. No. 2798.

*DIACHEA BULBILLOSA* (Berk. & Br.) List. In addition to earlier records (*Mycologia* 30: 341-342. 1938) the species has been found at various times in Indiana, Kansas, North Carolina, and Ontario, as represented by specimens here. N. Y. B. G. Nos. 2872, 8598, 8790, 9363, 9364, 9578.

*DIACHEA CAESPITOSA* (Sturg.) List. The species resembles *Diachea cylindrica* Bilgr., and is closely related but has different spores. In *D. cylindrica* they are reticulated with spines. In *D. caespitosa* they have prominent warts. A typical example was collected by Mr. Eli Davis at Byron, Ontario, in August, on the tips of sphagnum moss. Mr. Davis writes that the plasmodium observed was orange-yellow when commencing to fruit. N. Y. B. G. No. 9562.

*DIACHEA MIYAZAKIENSIS* Emoto. The first North American collections, made by Mr. Eli Davis in Ontario, were reported by Dr. John Dearness in *Mycologia* 32: 265. 1940. The species was found again by Mr. Davis at Komoka, Ontario, in August. Mr. Davis writes that he believes the three collections made during 1939 and 1940 were on black ash, although the wood was too far gone to permit positive identification. N. Y. B. G. No. 9363.

*DIACHEA SPLENDENS* Peck. Beautiful examples of the species have come here from Mr. Travis E. Brooks collected in Riley County, Kansas, in September. In addition to earlier records (*Mycologia* 30: 340. 1938) it is also here from Massachusetts and Ohio. N. Y. B. G. Nos. 9580, 9581, 12569, 12571.

*DIACHEA SUBSESSILIS* Peck. The species is well distributed in North America, and may be looked for almost anywhere in wooded regions. It fruits on leaves, forms small colonies, and may be distinguished from other globose *Diacheas* by the spores which have the warts arranged in reticulate fashion. In the Herbarium of the New York Botanical Garden there are more than 25 speci-

mens from Colorado, Connecticut, Florida, Kansas, Massachusetts, New York, Pennsylvania, Ontario, and Quebec. It is not rare.

*DIANEMA CORTICATUM* List. Collected by Mr. Eli Davis at Komoka, Ontario, in September. We have also found it on different occasions in past years in Pike County, Pennsylvania. The eastern collections have little or no capillitium, but may be distinguished from *Licea flexuosa* Pers., with which it is often associated, by the brown, translucent walls and clustered spores. N. Y. B. G. No. 9567.

*DIDERMA OCHRACEUM* Hoffm. In September we visited the small, wet swamp in Pike County, Pennsylvania, where three years ago, in the same month, we had found many developments of *Fuligo muscorum* Alb. & Schw. Nothing was seen of that species, but instead, we found on careful search of the ground mosses a few small fruitings of *D. ochraceum*. Each of these had less than a dozen finely matured and typical sporangia, clustered somewhat on the tips of moss. The angular lime-granules are prominent in many of the sporangia. The capillitium is purplish-brown, and the spores are purple-gray, distinctly spinulose, and measure 9–10  $\mu$  diam. The species has been rarely reported from North America. N. Y. B. G. No. 2704.

*DIDERMA ROANENSE* (Rex) Macbr. A small, typical development with flattened sporangia on black stalks was found on a mossy log in Pike County, Pennsylvania, in October. The black stalks separate the species from *Diderma radiatum* (L.) Morg. when the sporangia and columellae are more rounded like in the latter species. A collection was also made by Dr. Roy F. Cain at Kearney Lake, Algonquin Park, Ontario, in September 1939. N. Y. B. G. Nos. 2702, 9424.

*DIDERMA SPUMARIOIDES* Fries. Several of the Mycetozoa show marked differences in the fruit of the early spring as compared with that of the later summer. The May and June fruitings of *D. spumarioides* have usually more rounded and even sporangia with smoother, thinner walls. They are more scattered and with little or no hypothallus. In August and September, the massive forms develop. The sporangia are rough, closer together, and

with thick walls embedded in a heavy hypothallus. It has been noted by other authors that lime is occasionally present in the capillitium. A collection made in Pike County, Pennsylvania, in June, has numerous, long, fusiform lime-knots like a *Physarum*. A specimen collected by Dr. W. C. Sturgis in Colorado, in September 1912, has similar lime-knots, and others found by him have long, thin, flattened or cylindrical columellae, which are often bifurcate, and extend to the tops of the high sporangia. N. Y. B. G. Nos. 2807, 7168, 13203, 13204.

*DIDYMIUM COMPLANATUM* (Batsch) Rost. A specimen was found by Mr. W. D. Sutton in Sevier County, Tennessee, in August 1939, during the Foray of the Mycological Society of America. It is in the form of a very thin, effused plasmodiocarp with little capillitium. The yellow vesicles are present and characteristic of the species. N. Y. B. G. No. 9564.

*DIDYMIUM LISTERI* Massee. The conceptions of *Didymium dubium* Rost. and *D. Wilczekii* Meylan as expressed in the 3rd edition of the Lister Monograph were altered by Miss Lister (Jour. Bot. 45: 226-227. 1926) so that the former *D. dubium* is now regarded as *D. Listeri* Massee, and the former *D. Wilczekii* as *D. dubium* Rost. These conclusions have been generally accepted. *D. Listeri* is a lowland species, and *D. dubium* occurs in mountainous regions. Either one has been rarely reported from North America.

*D. Listeri* often forms thin, effused plasmodiocarps with a closely combined layer of crystals on a thin, membranous wall, and a sprinkling of stellate crystals on the surface. The spores are purple-gray, and generally not larger than  $11\ \mu$  diam. *D. dubium* is much more robust with pulvinate plasmodiocarps and heavier lime deposits, sometimes like in certain species of *Lepidoderma*. The spores are generally more than  $11\ \mu$  diam., and purple-brown. In both species the threads of the capillitium are more or less connected by transverse bars in addition to forking and branching. An examination of a dozen authentic English and Swiss specimens in the Herbarium of the New York Botanical Garden shows considerable variation in the characters, even to the spores, and a

particular character of one species may be present in a development of the other, or absent entirely.

Mr. Travis E. Brooks has sent here three specimens collected in Geary and Riley Counties, Kansas, in June and August, which are practically alike, and which I regard as the present species, rather than *D. dubium*. The fructifications are in thin, effused plasmodiocarps, sometimes branching or net-like. The compact wall of lime crystals is not present, and the stellate crystals are distributed directly on the inner membranous wall. The capillitium has the transverse bars. The spores are purple-gray, 9.5–11  $\mu$  diam. An English specimen of *D. Listeri* shows plasmodiocarps with scanty lime and others without any, and is very much like the Kansas specimens.

There are a number of species of *Didymium* that occasionally form plasmodiocarps in outward appearance like the Kansas gatherings. They are met with frequently, and some of them are not clearly determinate. The majority are *D. squamulosum* (Alb. & Schw.) Fries with purple-brown spores. Others with purple-gray spores are nearer *D. anellus* Morg. In these species the threads of the capillitium are not connected by bars. N. Y. B. G. Nos. 9373, 9376, 9377.

*DIDYMIUM OCHROIDEUM* G. List. The species was found four times by Mr. Travis E. Brooks in Geary and Riley Counties, Kansas, in August. One of the developments is perfectly typical. The others are more or less paler in color, with the sporangia more pulvinate, and spores 7–9  $\mu$  diam. Mr. Eli Davis also found the species fruiting in June on manure in a greenhouse at Byron, Ontario. He sends two specimens taken a week apart. The earlier collection has ochraceous-yellow plasmodiocarps with pale, slightly grayish spores 8.5  $\mu$  diam. In the later specimen the plasmodiocarps are almost white, and the spores are pale but distinctly brownish. They measure 8.5–9.5  $\mu$  diam. These irregularities have been noted before in earlier collections. N. Y. B. G. Nos. 9378, 9379, 9380, 9381, 9565, 9566.

*DIDYMIUM PARIETALE* Martin & Brooks, Trans. Am. Micr. Soc. 57: 319–321. 1938. Mr. Brooks, the junior author, has kindly furnished me with additional collections made in Geary and Riley

Counties, Kansas, in June and August, which are practically identical with the earlier collections made each season since 1937. The interesting combination of characters, including the vesicular bodies among the spores, seems to be constant, and makes this a sharply differentiated species. N. Y. B. G. Nos. 9382, 9383, 9384.

*FULIGO SEPTICA* (L.) Weber. In my Notes Series I (Mycolgia 29: 398-400. 1937), I described aethalia of this species found in great numbers at Middleburg, New York, and evidently from single plasmodia which had divided at the time of fructification. We have not found similar forms again. Prior to date of publication, I sent specimens to Prof. G. W. Martin, at Iowa City, Iowa, and he wrote to me that he regarded them as splendid examples of *Fuligo intermedia* Macbr., remarking at the same time that the original description of the latter was faulty. *F. intermedia* was described in part, as having a thin, fragile, grayish or brownish, non-calcareous cortex, and pale purple spores, gray or violaceous-gray in mass. In those respects the description does not agree with the Middleburg specimens. The description of Macbride has led to uncertainty as to what was meant by *F. intermedia*. The Listers have regarded it as *F. cinerea* (Schw.) Morg. var. *ecorticata*, but it does not seem to fit there. I have tried to reconcile it with small aethalia of *F. septica* having a thin brownish, non-calcareous cortex—and these are common enough—but not satisfactorily. There are so many phases of *F. septica*, and the aethalia in forming are so susceptible to outside influences, that these influences must be considered when regarding any development as separated specifically from *F. septica*.

During August and September, Mr. Travis E. Brooks and Mrs. Brooks found in Edwards and Riley Counties, Kansas, developments that are practically identical with those we collected at Middleburg, even to the double walls in many of the outside sporangia. Mr. Brooks writes he found them abundantly on a group of cottonwood logs, also on elm, in the vicinity of Manhattan, Kansas, with similar variations observed in our material. Here again the indications are there were large plasmodia, and large plasmodia are characteristic of *F. septica*.

I believe Macbride's description was intended to cover forms like those mentioned, and it may be convenient to accept them as *F. intermedia* if the description can be altered satisfactorily. Nevertheless, I am convinced they are no more than phases of *F. septica* developed under certain conditions, and that *F. intermedia* is not a valid species. The opinion is fortified by the references to ecorticate aethalia in the descriptions and notes of *F. septica* as given in the various editions of the Lister Monograph, to which the reader is referred. N. Y. B. G. Nos. 9387, 9388, 9389, 9390.

**KLEISTOBOLUS PUSILLUS** Lipp. This small inconspicuous species is probably very common on dead, coniferous wood, as we find it frequently associated with larger forms. The subglobose sporangia cannot be seen in the field unless acquainted therewith. They are brown in color and circular in shape, with distinct, shining lids. The species forms large colonies with many sporangia. One such found in Pike County, Pennsylvania, in August, was more than four feet in length, our idea of the size being limited by the strip of wood we brought back. N. Y. B. G. No. 2629.

**LAMPRODERMA VIOLACEUM** (Fries) Rost. In the description of the species as given in the Lister Monograph, it is stated that the peridium is often sprinkled with small, hyaline rods. Four collections of this odd variation were made in Pike County, Pennsylvania, in July, August, and September, during the time that the species develops abundantly on leaves. Later, in the autumn, the species forms large colonies on wood. The hyaline rods, which are up to  $100\mu$  in length, are usually firmly imbedded in the peridium. They appear to have a mineral nature but do not react to hydrochloric acid. N. Y. B. G. Nos. 2690, 2691, 2800, 2805.

**LEPIDODERMA TIGRINUM** (Schrad.) Rost. Two small, but well matured fruitings were found on mossy logs in different areas of Pike County, Pennsylvania, in October. A larger and much better development was uncovered by W. D. Sutton and Eli Davis in Dorchester swamp, Middlesex County, Ontario, in late November. The latter extended to more than 20 feet on a dead, larch log covered with mosses. The species has not been reported often

from eastern North America. It probably fruits towards the end of the season only, and on the habitats mentioned. N. Y. B. G. Nos. 2738, 2743, 9568, 9569.

*LYCOGALA EPIDENDRUM* (L.) Fries. The variety *tessellatum* was found in Pike County, Pennsylvania, in August. Collections were also made by Mr. Travis E. Brooks in Geary County, Kansas, in July, and by Mr. W. D. Sutton in Middlesex County, Ontario, in September. N. Y. B. G. Nos. 2686, 9396, 9397, 9570.

*Physarum Bilgramii* nom. nov. The name is proposed in place of *Physarum lilacinum* Sturg. & Bilgr. (*Mycologia* 9: 324. 1917) which is untenable under the present Rules of Nomenclature as it was used by Fries (*Syst. Myc.* 3: 141. 1829) for a form now regarded as *Badhamia lilacina* (Fries) Rost.

In the Herbarium of the New York Botanical Garden are four specimens of the species collected by Mr. Hugo Bilgram at various places in and about Philadelphia during the years 1910, 1912, and 1928. They show some differences in the intensity of the lilac tint which is the only specific character, as otherwise the form is like *Physarum globuliferum* (Bull.) Pers. We have found developments of the latter species, occasionally, which show this tint in a slight degree, but not sufficiently to regard them as *P. Bilgramii*. Mr. Rispaud found in Pike County, Pennsylvania, in July, two specimens which are well marked in the lilac color, one of them close to a specimen of Bilgram, and the other somewhat paler. Both are distinctly lilac when viewed in mass by daylight. These belong here, and it is probably best to continue to recognize the form as a species for purposes of classification, although it is clear to me that the color is not due to any inherent qualities in the plasmodium. Like in the formation of various colored forms of calcite it is probably caused by the presence of a slight amount of another mineral, perhaps manganese. This other element, present in the habitat of the plasmodium and absorbed thereby, would color the lime. Similar conditions are found in *P. citrinum* Schum., and *P. murinum* List. where many forms intermediate in color with *P. globuliferum* are found, and deeply colored forms are rarer. It would be interesting to develop laboratory cultures from some of these forms and see if the resulting fruit would show continued

tints, or revert to the white of *P. globuliferum*. N. Y. B. G. Nos. 2785, 2787.

PHYSARUM GLOBULIFERUM (Bull.) Pers. In *Mycologia* 30: 349. 1938, I reported a collection with *Badhamia*-like capillitium. A similar development was found in Pike County, Pennsylvania, in August, which also has large, white, angular or branching lime-knots. Other characters are those of *P. globuliferum*. It is possible that similar forms will be found more frequently in calcareous regions, and the conception of the species should be broadened to cover them along with the usual phase having small, rounded lime-knots. N. Y. B. G. No. 2769.

PHYSARUM LISTERI Macbr. Collected by Travis E. Brooks and Mrs. Brooks in Riley County, Kansas, in September. The species has now been found repeatedly in Colorado, Kansas, North Carolina, Tennessee, Virginia, and Quebec, showing a wide distribution. It fruits on old leaves and is probably not uncommon. N. Y. B. G. No. 9406.

PHYSARUM MUTABILE (Rost.) List. An undoubted specimen of the species has come here from Dr. Roy F. Cain of the University of Toronto, collected by W. R. Watson at Bear Island, Lake Timagami, Ontario, in September 1923. The specimen, on an herbaceous stalk, is scanty unfortunately, but sufficient to recognize the species. The white, sessile, subglobose, and rugolose sporangia have single walls with evenly distributed lime-granules. The capillitium is a close, persistent, network of pale, hyaline threads, with few lime-knots, the lime generally aggregated in the center to form a clavate columella to the top of the sporangium, or shorter, or missing entirely. The spores are purple-brown, minutely spinulose, 9–10  $\mu$  diam. The specimen agrees in every particular with authentic specimens from England, Moldavia, and Italy, in the Herbarium of the New York Botanical Garden.

When stalked, the sporangia bear a superficial resemblance to some phases of *Craterium aureum* (Schum.) Rost., but can be distinguished by the persistent capillitium which retains the sporangial shape after dehiscence and spore dispersal. It is said to form large colonies, and should be found again in greater abundance in

the forests of Ontario and Quebec on heaps of old leaves, straw, etc. N. Y. B. G. No. 9551.

*PHYSARUM OVISPORUM* G. List. I have received from Mr. Travis E. Brooks two specimens collected in Riley County, Kansas, in September, that are much nearer to the published description of this species than those reported from Long Island in *Mycologia* 29: 404-405. 1937. The sporangia are sessile and white; the lime-knots in the capillitium are numerous, of varying sizes and rounded, with very few angular; the spores are rather dark, dull, purplish-brown, and almost all of them are distinctly ovoid in shape. The minor differences seem to be of little importance if the principal distinguishing characters of the species are the ovoid spores combined with the rounded lime-knots. The two collections are regarded here as *P. ovisporum*. N. Y. B. G. Nos. 9411, 9412.

*PHYSARUM SUPERBUM* Hagelstein. Several collections were made by Travis E. Brooks, John Hudspeth, and J. Koepper in Geary and Riley Counties, Kansas, in June, August, and September, and also by Eli Davis and W. D. Sutton at Mount Brydges, Ontario, in October. Considerable range in color is shown by the various specimens, but this is characteristic, and due to varying conditions prevailing at the time of fructification. N. Y. B. G. Nos. 9415, 9416, 9417, 9571, 9572.

*STEMONITIS FUSCA* Roth. I have often been asked the question as to how long specimens of the Mycetozoa will keep when properly boxed. In the Herbarium of the New York Botanical Garden there is a specimen of *S. fusca* collected on Staten Island, New York, in July 1818, and another found at White Sulphur, Virginia, in June 1838. That should be a sufficient answer. N. Y. B. G. Nos. 6557, 6798.

*STEMONITIS VIRGINIENSIS* Rex. The species is based entirely upon the spore characters. All others are of little importance. The spores are pale lilac-brown, 6-8  $\mu$  diam., and reticulated with narrow, raised bands, the meshes ranging from 6 to 12 on the hemisphere in the specimens we have here. The color of the sporangia varies slightly; the size varies from 2 to 12 mm. or

more; and they may be cylindric or acuminate. The stalks may be long or short. The form is a *Stemonitis* because occasionally the surface net is well developed to nearly the apex of the sporangium. More often it is developed only in the lower part, or not at all, when the form looks like a *Comatricha* with many free ends to the capillitium. A specimen in the Herbarium of the New York Botanical Garden collected by Rex at Mountain Lake, Virginia, the type locality—but not regarded as part of the type collection although it may be—has a poorly developed net with many free ends. The spore characters are remarkably uniform throughout these various phases, and are different from those of any other *Stemonitis*.

*Comatricha reticulata* Gilb. (Am. Jour. Bot. 19: 140. 1932) is probably a phase of the present species, judged by the description which reads like a description of *S. virginiensis* except for slight irregularities in the capillitium. Many specimens in the Herbarium of the New York Botanical Garden.

TRICHIA ALPINA (R. E. Fries) Meylan. A specimen has come from Dr. Roy F. Cain of the University of Toronto, collected by G. D. Darker at Lake Timagami, Ontario, in 1923. The fructification is in short plasmodiocarps with dark, thick walls. The elaters of the capillitium are yellow, 4–5  $\mu$  thick, with close, regular spirals. The spores are yellow, faintly marked with warts or spines, and measure 15–18  $\mu$  diam. An inner wall is not evident. N. Y. B. G. No. 9425.

THE NEW YORK BOTANICAL GARDEN

## CONTRIBUTIONS TO THE MYCOFLORA OF BERMUDA—II

F. J. SEAVER AND J. M. WATERSTON

(WITH 2 FIGURES)

In connection with the mycological explorations of Bermuda the writers noted an unusually large number of specimens of the genus *Stictis*. Comparative study revealed the fact that there are not only numerous specimens, but that they apparently comprise several distinct species.

The genus *Stictis*, while in a broad sense included with the Discomycetes, is usually placed in the order Phacidiales, while the term Discomycetes is often restricted to the Pezizales. The genus which is at least a close ally of the Discomycetes is characterized by its usually rounded but occasionally slightly elongated apothecia which are at first immersed in the host substratum, later dehiscing with a prominent margin which may remain entire or become split into several rays or lobes, the hymenium remaining below the surface of the substratum. The exposed margin is usually white, but may be occasionally slightly colored. The spores are filiform and usually nearly as long as the ascus.

The type species *Stictis radiata* is common on wood and twigs. A number of the Bermuda species occur on leaves and herbaceous stems. The following is a summary of the forms encountered in Bermuda. This contribution is based on collections made on the three expeditions, as outlined in the first of the series of papers (see *Mycologia* 32: 388. 1940).

### KEY TO THE SPECIES OF STICTIS OCCURRING IN BERMUDA

On dicotyledonous hosts (rarely on both monocots and dicots).

Spores 100  $\mu$  or more in length.

Exposed margin of apothecia white, more or less lacinate or crenate.

Spores 140–150  $\mu$  long. ....1. *S. radiata*.

Spores 100–110  $\mu$  long, on *Conocarpus*. ....2. *S. Conocarpi*.

- Exposed margin of apothecia pink, nearly even, scarcely laciniate,  
on some herbaceous stem. ....3. *S. carnea*.  
Spores less than 100  $\mu$  long, usually 70–75  $\mu$ .  
Apothecia margin usually 5-lobed on *Coccolobis*. ....4. *S. Coccolobii*.  
Apothecia margin usually 4-lobed on *Pimenta*. ....5. *S. Pimentae*.  
On monocotyledonous hosts.  
Apothecia white, rounded, spores 175–180  $\mu$  long, on banana sheaths.  
6. *S. Musae*.  
Apothecia much elongated about 3 times as long as broad, spores 50–60  $\mu$   
long, on sheaths of grass. ....7. *S. lophodermioides*.  
On fern stipes, *Acrostichum excelsum* Maxon : ....8. *S. filicicola*.

1. *STICTIS RADIATA* (L.) Pers. ex Fries, Syst. Myc. 2: 194. 1822  
(FIG. 1a).

Specimens collected on old flowering stalks of *Agave* appear to be this species, although apparently not previously reported on this host. Brown, Britton & Seaver 1336; Seaver & Whetzel 47.

2. *Stictis Conocarpi* sp. nov. (FIG. 2a).

Apothecia sparingly scattered, at first immersed becoming erumpent, the margin splitting into several lobes (usually about 4), white, not exceeding .5 mm. in diameter; hymenium darker; asci cylindric 125  $\times$  10–12  $\mu$ ; spores filiform 100–110  $\mu$  long; paraphyses filiform.

Apotheciis sparsis primo immersis dein erumpentibus, candidis, margine prominulo laciniato; ascis cylindræis, 125  $\times$  10–12  $\mu$ ; sporiis filiformibus, 100–110  $\mu$  long; paraphysibus filiformibus.

On leaves of *Conocarpus erecta* L., Seaver & Whetzel 10.

3. *Stictis carnea* sp. nov. (FIG. 1c).

Apothecia gregarious, not exceeding .5 mm. in diameter, at first immersed, the margin becoming slightly prominent, the entire fungus and surrounding tissue flesh-colored, the inside of the exposed margin lighter, almost white, the margin nearly even and only slightly elevated; asci cylindric, tapering above, 8-spored, reaching a length of 225–250  $\mu$  and a diameter of 12  $\mu$ ; spores filiform, many-septate reaching an extreme length of 200  $\mu$  or rarely more, and a diameter of 3–4  $\mu$ ; paraphyses very slender, scarcely more than 1  $\mu$  in diameter.

Apotheciis gregariis .5 mm. diam. in subiculo carneo primo immersis dein erumpentibus, margine prominulo carneo non laciniato; hymenio leniter carneo; ascis cylindræis, 225–250  $\mu$  long., 12  $\mu$  diam.; sporiis filiformibus 200  $\mu$  long., 3–4  $\mu$  diam.; paraphysibus filiformibus vix 1  $\mu$  diam.

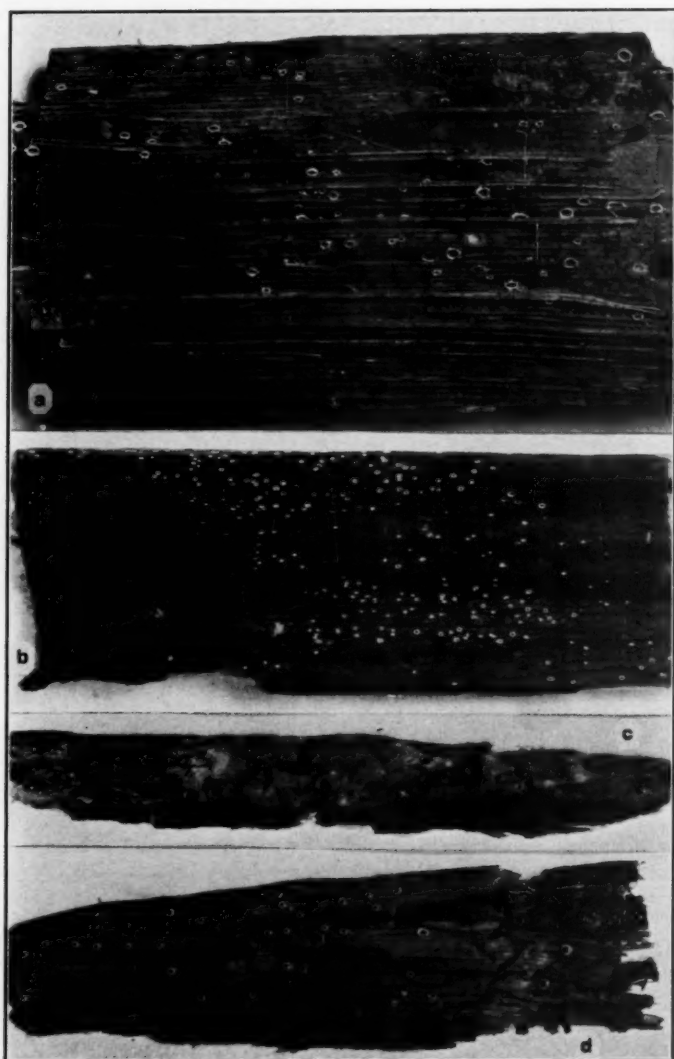


FIG. 1. *a*, *Stictis radiata*; *b*, *Stictis flicicola*; *c*, *Stictis carnea*; *d*, *Stictis Musae*.  $\times 2.5$ .

On some undetermined stems, Seaver & Whetzel 5. Fruitlands, Jan. 15, 1926.

4. *STICTIS COCCOLOBII* Seaver & Waterston, *Mycologia* 32: 399. 1940.

On fallen leaves of *Coccolobis uvifera* (L.) Jacq. Seaver & Waterston 13, 196; Seaver & Whetzel 26, 62, 79.

5. *Stictis Pimentae* sp. nov. (FIG. 2b).

Apothecia rather thickly scattered over the underside of the leaves, scarcely exceeding .5 mm. in diameter, at first immersed becoming erumpent, the epidermis of the host folding back in several (usually 4) lobes, exposing the hymenium which is nearly white; asci cylindric, reaching a length of 70–75  $\mu$  and a diameter of 8  $\mu$ ; spores nearly as long as the ascus (difficult to remove) and about 2  $\mu$  thick, many-septate; paraphyses very slender, about 2  $\mu$  thick.

Apotheciis sparsis plerumque hypophyllis, .5 mm. diam. primo immersis dein erumpentibus laciniatis, niveis; hymenio pallido; ascis cylindraceutis, 70–75  $\mu$  long., 8  $\mu$  diam.; sporiis filiformibus pluriseptatis 65–70  $\mu$  long.; paraphysibus filiformibus 2  $\mu$  diam.

On leaves of allspice *Pimenta officinalis* Lindl. Collected at Fruitlands, Jan. 15, 1926, Seaver & Whetzel 8; also near the Experiment Station, Jan. 27, 1926, Seaver & Whetzel 51.

6. *Stictis Musae* sp. nov. (FIG. 1d).

Apothecia thickly gregarious, deeply immersed becoming erumpent with the margin prominent slightly rolled back, nearly even not lacinate, white, the hymenium slightly pinkish; asci subcylindric reaching a length of 180–200  $\mu$ ; spores nearly as long as the ascus and about 2  $\mu$  in diameter, many-septate (usually about 40); paraphyses present very slender.

Apotheciis gregariis, erumpentibus, margine prominulo non laciniato, candido, hymenio pallido vel leniter carneo; ascis subcylindraceutis, 180–200  $\mu$  long.; sporiis filiformibus, multiseptatis; paraphysibus filiformibus.

On the sheaths from banana stems (*Musa* sp.), Seaver & Whetzel 76.

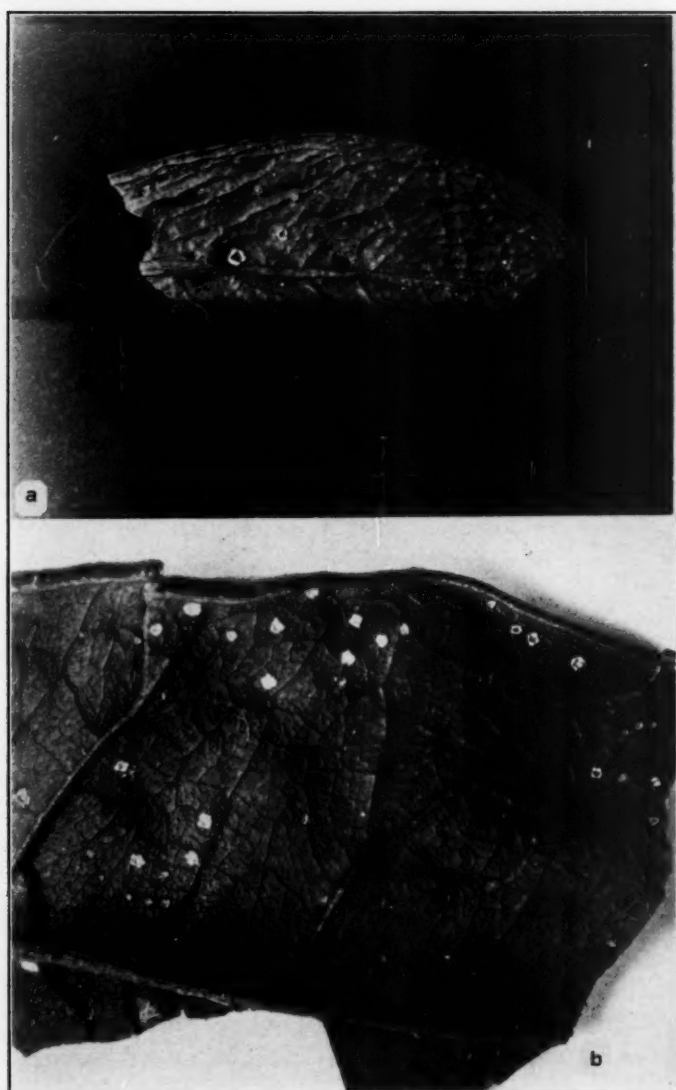


FIG. 2. a, *Stictis Conocarpi*; b, *Stictis Pimentae*.  $\times 2.5$ .

7. *STICTIS LOPHODERMIOIDES* Seaver & Waterston, *Mycologia* 32: 400. 1940.

On stems of grass. Brown, Britton & Seaver 1469.

8. *Stictis filicicola* sp. nov. (FIG. 1b).

Apothecia gregarious, minute .3-.5 mm. diam., rounded or slightly elongated, immersed, bursting open, the exposed inner margin pure white scarcely laciniate, nearly even or delicately crenate; hymenium sunken, somewhat darker than the exposed margin; asci cylindric reaching a length of 180-200  $\mu$  and a diameter of 8  $\mu$ , 8-spored; spores filiform reaching a length of 100-150  $\mu$ , usually about 120  $\mu$ , many-septate, usually with about 30 septa which are about 4-6  $\mu$  apart; paraphyses filiform, about 1-1.5  $\mu$  in diameter.

Apotheciis gregariis, .3-.5 mm. diam. primo immersis, dein erumpentibus candidis, margine prominulo vix laciniato; hymenio pallido; ascis cylindraceis, 180-200  $\mu$  long., 8  $\mu$  diam.; sporiis filiformibus, 100-150  $\mu$  long. multi-septatis, paraphysibus filiformibus, 1-1.5  $\mu$  diam.

On stipes of giant fern (*Acrostichum excelsum* Maxon), Brown, Britton & Seaver 1322.

RECENT OBSERVATIONS

Since the above was written the senior writer made a fourth visit to Bermuda, covering the period from November 24 to December 12, 1940, to work in collaboration with the junior author. Although our work during this short period was impeded by a rather unusual rainfall, numerous collections were obtained and a number of observations bearing on the present report were made. A special effort was made to check up on the species reported here and in the previous contribution as new to science.

In 1912 specimens were collected abundantly on old poles of *Agave* which were referred to *Stictis radiata* the type species, and one which is known on woody and occasionally on herbaceous stems throughout North America, the West Indies and into South America. During our recent visit numerous poles of *Agave* have been carefully examined, but this fungus was not again found. It may be located later.

The second species listed here, *Stictis Conocarpi*, was collected sparingly on leaves of *Conocarpus erecta* L. by H. H. Whetzel on

Jan. 22, 1926. Although a diligent search was made for this it was not re-collected. This may be due to the fact that it was not the proper season. Other attempts will be made to locate the species which seems distinct.

Not knowing the habitat of the third species mentioned we had no clue on which to work, and no special attempt was made to locate it.

The fourth species recorded here, *Stictis Coccolobii*, was described by the authors in a previous paper (Mycologia 32: 399, f.2) from material collected by them on December 13, 1940, at Grape Bay. The same region was searched during our recent foray and this species was again found to be abundant on the fallen leaves provided the conditions were favorable, for not only is it necessary to have the proper host but the conditions of moisture must also be right.

The fifth species, *Stictis Pimentae*, here described as new was first collected in 1926 near the Agricultural Station and at Fruitlands, Warwick, on fallen leaves of allspice. Special search was made in Warwick Parish where the host was known to occur and spread freely, and the fungus was again found to be present and apparently well established on the fallen leaves of the host indicated above. At the same time it was not detected on the leaves of any other plant.

The sixth species recorded in this paper, *Stictis Musae*, was collected on banana petioles in a garden near the Agricultural Station, February 2, 1926. During our recent visit it was not found. Possibly it occurs later in the season.

The last species referred to in this paper, *Stictis filicicola*, occurred on the petioles of the giant fern *Acrostichum excelsum* Maxon. This was at first also referred to *Stictis radiata*. Recent comparative studies, however, have convinced the writers that this is a distinct species. On November 28, 1940, a visit was made to Paget Marsh where the giant fern grows in great profusion. One of our objects was to re-collect if possible this fungus. Almost the first handful of dead stems of this fern showed the *Stictis* to be present in great abundance. A careful search was then made of other ferns, including *Osmunda cinnamomea* L., as well as the

stems of other plants, but the fungus was not found on any other host. The persistence of this fungus on the petioles of *Acrostichum* over a period of twenty-eight years tends to confirm our belief that it is specifically distinct.

#### EXPLANATION OF FIGURES

All photographs are made from dried material and enlarged about 3 times.

THE NEW YORK BOTANICAL GARDEN

AND

AGRICULTURAL EXPERIMENT STATION,

PAGET EAST, BERMUDA

## MYCOLOGICAL NOTES. V

C. L. SHEAR

A critical examination of some of our common North American Pyrenomycetes and comparison with those of Europe shows that they have been erroneously identified. This might naturally be expected when it is remembered that the early mycologists, such as Fries and Schweinitz, did not describe the spores and other microscopic characters which are now known to be of great importance in specific determinations. A vast amount of study of type and authentic material of the older species must be made before any dependable lists of our species can be made and their synonymy determined, or any reliable data regarding their distribution obtained. The specimens of our common species even in our largest herbaria are so few and the material usually so poor and scanty that no satisfactory monographic studies can be made. One of our greatest needs for the advancement of mycological taxonomy is more and better material from all parts of the country and the world.

17. NUMMULARIA BULLIARDI Tul. Sel. Fung. Carp. 2: 43.  
pl. 5, f. 11-19. 1863

This fungus was first described according to Fries (Syst. Myc. 2: 348. 1823) by Micheli (Nov. Pl. Gen. 105, No. 5. 1729). However, Micheli's brief description without illustration is very doubtful. The only specimen of *Nummularia* Saccardo could find in Micheli's herbarium was *N. repandoides* Fuckel. (*N. clypeus* (Schw.) Cooke) labelled "Lithophytoïdes." The fungus was described by Bulliard (Champ. France 1: 179, tab. 468, f. 4. 1791) as *Hypoxylon nummularium*. His illustration seems to leave little doubt that he had the fungus renamed as above by Tulasne. The typical form is on beech, and shows the striking nummular shape almost exactly circular and about the size of a small coin. DeCandolle next described it as *Sphaeria nummularia*, Fl. Fr. 2: 290.

1805. Fries (l.c.) cites *S. macula* Tode (Fungi Meckl. 2: 33, pl. 13, f. 106. 1791) but the description and illustrations do not agree with Tulasne's fungus. He also cites *S. diffusa* Sow. Engl. Fungi, pl. 373, 1802, and *S. orbicularis* Pers. ined., as synonyms. We next find the fungus described by Schmidt as *S. anthracina* in Kunze & Schmidt, Myk. Hefte 1: 55, tab. 2, f. 14. 1817. The illustration cited leaves no doubt that it is the same as that so fully described by Tulasne. The subglobose ascospores shown are typical.

Tulasne (l.c.) gives a very complete description and illustrations of the fungus, including its conidial stage. He cites *S. diffusa* Sow., as a doubtful synonym; also *S. anthracina* Schmidt (l.c.). He says the conidia develop under the bark and break through the clefts in the form of a very abundant pure white powder consisting of very minute spores hardly more than  $5\mu$  in diameter. The loosened bark is covered on its inner surface with a rather thick stratum of fleshy, dingy white fungus parenchyma. We have observed specimens of *N. clypeus* (Schw.) Cooke in its conidial condition on oak from Virginia with a similar growth. Tulasne (l.c. 45) reports it on beech only, and says that among the specimens found in the herbarium of the Paris Museum which agree best in form and habit with this species, are *Sphaeria clypeus* Schw. from North America, *S. anthracodes* Fries from Brazil and Chile, and *S. pachyloma* Lév. The specimen of *S. clypeus* to which he refers is probably that sent by Schweinitz to Brongniart about 1823, before Schweinitz had abandoned his name and labelled his specimens *S. nummularia* (Bull.) Fries.

Nitschke (Pyren. Germ. 60. 1867) cites Currey's figure (Act. Soc. Linn. Lond. 22: 268. f. 59. 1858) as representing this fungus and also DeNotaris (Microm. Ital. 9: f. 1. 1853) as well as the following exsiccati: Moug. & Nestl. Stirp. Vog. Rhen. 374, and Fuckel, Fungi Rhen. 1062. Following the description he says: "I succeeded in finding the conidial stage as described by Tulasne on fallen beech trunks. The fine powdery conidia covered the disk of the stroma with a chalk-like layer which finally disappeared and left the surface a dark earthy brown color. This disappears and the surface becomes blue-gray with black punctate ostioles." He found it only on *Fagus sylvatica*, but mentions that Fries reports it

on other hosts. He describes the ascospores as oval to subglobose, measuring  $12-14 \times 6-10 \mu$ . Fries (Summa Veg. Scand. 384. 1849) records it as *Hypoxylon nummularium* Bull. and reports it as found in Scandinavia, citing Berk. Brit. Fun. Exs. 28. We have not seen this number.

Ellis and Everhart (N. Am. Pyren. 624. 1892) describe *N. Bulliardii*, and give the spore size as  $12-15 \times 7-9 \mu$ , which is the size of spores in typical specimens of this species in Europe. They cite as examples Rab. Fungi Eur. 2956; and Rehm Ascom. 977 which are typical *N. Bulliardii*. Ellis and Everhart N. Am. Fungi 85 is typical *N. clypeus* on oak. Under *N. clypeus*, Ellis and Everhart (No. Amer. Pyren. 627-28) translate Schweinitz' original diagnosis and give the spore measurements as  $20 \times 8 \mu$ , which agrees with those given by Cooke, and add "On branches of *Catalpa*, Curtis; on oak, Ravenel."

An examination of numerous European and American specimens shows that these two species are easily separated, especially by the size and shape of the ascospores. Ellis, however, was mistaken in referring American specimens, mostly on oak, to *N. Bulliardii*, since his No. 85 cited above and other specimens identified by him and others in this country are not *N. Bulliardii* Tul. Schweinitz in his original description gives *Tilia* and *Acer rubrum* as hosts for his *Sphaeria nummularia* (*S. clypeus* Schw.).

We have examined the following European specimens of *N. Bulliardii*: P. Strasser, Sonntagsberg, on beech, spores  $9-14 \times 6-9 \mu$ ; Fuckel, Fungi Rhen. 1062, issued as *Hypoxylon* on *Fagus*, Nassau, spores  $9-13 \times 6-9 \mu$ ; Krypt. Exs. Mus. Pal. Vind. 516, issued as "*N. nummularia* (Bull.) Keissl.," collected by Niessl, Brunn, on *Fagus*, spores  $9-13 \times 6-9 \mu$ . All the specimens of true *N. Bulliardii* we have seen are on *Fagus*. Fries and Traverso report it on "*Acer*, *Carpinus*, *Castanea*, *Quercus*, etc."

DeNotaris (Micro. Ital. 9: pl. 1, f. 1-6. 1857) under *Hypoxylon nummularium* excludes as a synonym Tode's *S. macula*. He cites Berkeley, British Fungi 240. 1837. He also says that the synonym cited by Fries from Micheli is probably wrong as the description seems to him to apply to *Sphaeria stigma* Hoffm. or a variety of it. *S. macula* Tode he thinks also relates to *Sphaeria stigma* instead of this species and quotes Tode's words to that

effect. DeNotaris' Italian specimen cited was on dead branches of *Fagus* from the Apennine Mountains, collected by Cesati. He says it is rare. His illustration (l.c.) shows the nummular form of stroma with the typical subglobose to short, broadly elliptical ascospores. We have not yet seen a specimen of this species gathered in North America. The numerous American specimens under this name in the Lloyd, Ellis, and other Herbaria examined are mostly *N. clypeus* (Schw.) Cooke. The synonymy would appear to be as follows:

NUMMULARIA BULLIARDI Tul. Sel. Fung. Carp. 2: 43. pl. 5, f. 11-19. 1863.

*Hypoxyton nummularium* Bull. Champ. Fr. 1: 179. pl. 468, f. 4. 1791.

*Sphaeria nummularia* DC. Fl. Fr. 2: 290. 1805.

*Sphaeria anthracina* Schmidt in Kunze & Schmidt, Myk. Hefte 1: 55. pl. 2, f. 14. 1817.

*Sphaeria nummularia* (Bull.) Fries, Syst. Myc. 2: 348. 1823.

*Nummularia nummularia* (Bull.) Schröt. Pilz. Schles. 2: 458. 1897.

*Nummularia anthracina* (Schm.) Trav. Fl. Ital. Crypt. Pyren. 1: 57. f. 10. 1906.

*Kommamyce Bulliardii* (Tul.) Nieuwland, Amer. Mid. Nat. 4: 375. 1916.

*Numulariola nummularia* (Bull.) House, N. Y. St. Mus. Bull. 266: 49. 1925.

18. NUMMULARIA CLYPEUS (Schw.) Cooke, Grevillea 12: 6. 1883

Schweinitz under *Sphaeria* (Schr. Nat. Ges. Leipzig 1: 31. 1822) described this species as follows:

42. (S.) *Clypeus* Sz. *numularia* Decand. Flor. Gall. II, p. 290. Bulliard, t. 480. 3?

*S. explanata* ambitu elliptico immersa atro-nitens, ostiolis conicis prominulis exasperata.

Totus fungus cortici etiam vivarum arborum, Tiliae, Aceris rubri, immersus, clypeolum unciam unam ad tres longum, dimidium latum refert affixum claviculis, quorum capitula (ostiola sphaerularum) prominent; margine ligneo undulato cingitur. Facile potest excuti e lecto suo, cavitatem in ligno linquens.—Dura. Stroma nigrum parcius. Sphaerulae majores, profundius penetrantes. Pulvere seminali brunneo tecta reperitur interdum.

Later (Trans. Am. Phil. Soc. II. 4: 193. No. 1219. 1832) he mentions it as follows:

1219. 73. *S. numularia*, F. 57, Syn. Car. 42, *S. clypeus*, inveni specimina Pennsylvania septam uncias longa et lata 3-4. In variis-praeicipue *Quercus*.

Fries also cited *S. clypeus* as a synonym of *Sphaeria nummularia* Fries in Syst. Myc. 2: 348. 1823.

A careful examination of Schweinitz' specimens indicates that they are all clearly distinct from *Hypoxyylon nummularium* Bull. as was pointed out by Tulasne and Cooke (Grevillea 12: 6. 1883). Tulasne (Sel. Fung. Carp. 2: 44. 1863) who examined a part of Schweinitz' original specimen, says in a foot-note: "This pyrenomycete (*S. clypeus* Schw.) which grows usually on oak is rightly distinguished from our first *Nummularia* (*N. Bulliardii*) as appears from the words of Schweinitz himself both by the capitate and prominent ostioles of its conceptacles and by the brown seminal powder with which it is sometimes found covered." He also mentioned the very noticeable difference in size and shape of the ascospores. The specimen still remaining in the original packet in Schweinitz' herbarium with a gummed paper strip attached is probably from the original Salem collection. It has spores  $14-17 \times 7-9 \mu$ . There is another specimen in the mounted collection of his herbarium labelled "*Sphaeria numularia*  $\beta$  *striata* N. York." This is immature. The surface of the stroma is brown and the ostioles not so conspicuous as usual. The surface is somewhat striate, due apparently to linear irregularities in the inner surface of the bark of the host. The spores in this are typical,  $14-18 \times 7-9 \mu$ . As noted in our discussion of *N. Bulliardii*, Ellis' N. A. Fungi 85 on oak cited as that species has spores  $15-17 \times 6-7 \mu$  and is not *N. Bulliardii* Tul. (*Sphaeria nummularia* Fries), but *N. clypeus* (Schw.) Cooke.

We have examined specimens of *N. clypeus* from many states from Maine and Canada to Florida and west to Washington, Oregon and California on various hosts, including *Acer*, *Alnus rubra*, *Carpinus*, *Carya alba*, *Castanea*, *Diospyros*, *Fagus*, *Pasania densiflora*, *Quercus* spp., and *Rhus*. It occurs most frequently on oak and beech. Nearly all are labelled *N. Bulliardii*.

It is also found in Europe where it was described by DeNotaris (Microm. Ital. 6: 4. f. 2. 1851) as *Sphaeria mediterranea* (*Nummularia mediterranea* Sacc., *N. regia* var. *mediterranea* Trav.). An examination of DeNotaris' specimen in his herbarium at Rome shows that it agrees in every respect with *N. clypeus*. A mere form of this species was also described by DeNotaris (Sfer. Ital. 15. f. 12. 1863) (*Nummularia regia* [DeNot.] Sacc.) as *Hypoxyylon regium*. This was also illustrated by Saccardo (Myc. Ven. pl. 15, f. 37-40. 1873, and Fung. Ital. f. 585. 1879). Trav. verso (Fl. Ital. Crypt. Pyren. 1: 59. 1906) says that *N. mediterranea*, which he reduces to a variety of *N. regia* as above, differs especially in having the surface of the stroma irregular. From an examination of DeNotaris' specimen it is evident that this is due to the fact that the fungus was growing on thick, rough bark which causes the irregularities. The spores and all other characters are identical with those of *N. regia* and *N. clypeus*. Miller (Trans. Brit. Myc. Soc. 17: 129. 1932) says he has seen specimens of *Hypoxyylon mediterraneum* (DeNot.) Miller from Holland, Germany, and France. We have a fine specimen on *Quercus suber* from Portugal as *N. regia*.

This species was also described by Fuckel (Symb. Myc. 236. pl. 2, f. 46. 1869) as *N. repandoides*. A study of Fuckel's specimen (Fungi Rhen. 2266 on *Fagus*) shows that this also is identical with *N. clypeus*. We have one other specimen of *N. clypeus* on *Fagus* from Hanover, Germany, distributed by Rehm in his Ascom. 1769, incorrectly named *N. anthracina* (K. & S.) Trav. The spores are  $15-18 \times 7-8 \mu$ . The papillate ostioles and other characters agree with typical *N. clypeus* on beech in this country. Curiously enough Rehm issued under the same name as "forma juvenilis" his No. 1769-b, typical *N. Bulliardi* Tul. on *Fagus* from upper Bavaria. The great bulk of the material in herbaria in this country labelled *N. Bulliardi* is *N. clypeus*. We have yet to see a specimen of the true *N. Bulliardi* Tul. from North America. Saccardo (Syll. Fung. 1: 396. 1882) gives *N. clypeus* as a synonym of *N. Bulliardi*, but later (Syll. Fung. 9: 570. 1891) he follows Cooke (l.c.) in describing it as a separate species.

The synonymy so far as we know it at present is as follows:

- NUMMULARIA CLYPEUS (Schw.) Cooke, Grevillea 12: 6. 1883.  
*Sphaeria clypeus* Schw. Schr. Nat. Ges. Leipzig 1: 31. 1822.  
*Sphaeria nummularia* Schw. Trans. Am. Phil. Soc. II. 4: 193.  
1832. Non Fr.  
*Sphaeria mediterranea* DeNot. Microm. Ital. Dec. 6: 4. f. 2.  
1851.  
*Hypoxyton regium* DeNot. Sfer. Ital. 15. f. 12. 1863.  
*Hypoxyton clypeus* (Schw.) Curt. Cat. Pl. N. Car. 140. 1867.  
*Nummularia repandoides* Fuckel, Symb. Myc. 236. pl. 2, f. 46.  
1869.  
*Nummularia mediterranea* (DeNot.) Sacc. Syll. Fung. 1: 400.  
1882.  
*Nummularia regia* (DeNot.) Sacc. Syll. Fung. 1: 400. 1882.  
*Nummularia bulliardi* Ellis & Ev. N. Am. Pyren. 624. 1892.  
pp. Non. Tul.  
*Nummularia regia* var. *mediterranea* (DeNot.) Trav. Fl. Ital.  
Crypt. Pyren. 1: 59. 1906.  
*Hypoxyton mediterraneum* (DeNot.) Miller, Trans. Brit. Myc.  
Soc. 17: 129. 1932.

19. ROSELLINIA AQUILA (Fries) DeNot.

This pyrenomycete has been generally regarded as a common species throughout most of Europe and the United States, and has also been reported from China and other regions. It was described as *Sphaeria aquila* Fries, Vet. Akad. Hand. 1817: 251. It was also described by Fries in Syst. Myc. 2: 442. 1823. He cites Schmidt and Kunze, Deutsch. Schwäm. Exs. 52, labeled "*Sphaeria byssiseda* P." as representing his species. No description of spores was given. Those in the specimen of this number we have examined are  $15-21 \times 6-8 \mu$ . DeNotaris (Giorn. Bot. Ital. I: 334. 1844) described the genus *Rosellinia* using Fries' species, *R. aquila*, as the type. Tulasne (Sel. Fung. Carp. 2: 250. pl. 33, f. 1-6. 1863) gave a full description and illustration of this fungus. These agree entirely with the specimens of Schmidt & Kunze cited by Fries and leave no doubt as to the identity of the species. Besides the ascospores he describes and illustrates the conidial stage which is produced on the brown byssoid subiculum in which the perithecia are embedded. The conidia are borne in pale ashy-brown

corymbs. They are narrow ovate, hardly more than  $10\ \mu$  long. The conidial stage according to Tulasne has been described under various names as *Sporotrichum fuscum* Lk., *S. badium* Link, and *S. stuposum* Link (Ges. Nat. Freunde Berlin Mag. 3: 10. 1809), also as *Alytosporium fuscum* Link (Willd. Linn. Sp. Pl. IV. 6<sup>2</sup>: 23. 1825, and as *Thelephora vinosa* Pers. and *Hypochnus fuscus* Fries. He gives the ascospore measurements as about  $20 \times 7\ \mu$ .

Tode (Fungi Meckl. 2: 10-11. f. 69-70. 1791) described *Sphaeria byssiseda* with two varieties  $\alpha$  *grisea*, f. 69 and var.  $\beta$  *fusca*, f. 70. The variety *grisea* he says differs from *fusca* generally in having a livid gray color and smaller perithecia. Tode's description and illustrations leave little doubt that he had the same fungus described by Fries although no spore measurements are given and no specimens of his are known to exist. Fries (l.c.) cited *S. byssiseda*  $\beta$  *fusca* of Tode, as a synonym of his *S. aquila*. Tode's var.  $\alpha$  *grisea* Fries describes as a separate species under the name *S. byssiseda*, asserting that it is "bene distincta," and emphasizing the livid gray color and the broadly effuse subiculum. Most subsequent authors, however, regard both of Tode's varieties as mere forms of Fries' *S. aquila*. Berkeley, for example, in Smith's English Flora 5: (pt. 2, Fungi) 260. 1836, says that Tode's varieties which Fries says are distinct "run very much into one another." The gray form with scattered perithecia is apparently a young condition with abundant production of gray conidia.

Brefeld (Unters. Gesamt. Myk. 10<sup>2</sup>: 259. 1891) recognizing the great similarity between this species and certain species of *Hypoxyylon*, decided that it really belonged to that genus and called it *H. aquila* (Fries) Bref. Schröter (Krypt.-Fl. Schles. 3<sup>2</sup>: 299. 1894) adopted Tode's specific name and transferred it to *Rosellinia* on the basis of priority. Tulasne had also pointed out that the fungus has many truly hypoxylloid characters, the conidia being very similar to those of some species of *Hypoxyylon* and the perithecia sometimes coalescing. In view of our present knowledge of the relationship of this genus, it is difficult to understand why it should be placed in a different family from *Hypoxyylon* as has been done by Kirschstein (Trans. Brit. Myc. Soc. 18: 306. 1934). According to numerous European specimens we have examined the ascospores vary from  $14-23 \times 6-8\ \mu$ , mostly about  $16-18 \times 6-8\ \mu$ .

Kirschstein (l.c. 302), says that the mature ascospores have small, globose, hyaline appendages at each end which are a distinctive character. Winter says "typically without appendages" and Saccardo "with or without." In the numerous European specimens we have examined we have but very rarely been able to demonstrate the presence of any such appendage. The spores at maturity are surrounded by a thin, hyaline, gelatinous envelope, and in the immature asci they are surrounded by a mucilaginous cytoplasm which connects all the spores, and some small portion of this may remain attached to their ends when the spores are set free; but it seems that only under very favorable conditions and treatment can such an appendage be found in dried specimens. In some species, as *R. thelena* (Fries) Rab., a hyaline appendage appears to be a more constant character.

*R. aquila* occurs on many deciduous host plants in Europe and has been regarded by American authors as one of our most common species in this country. In our early collections of this species in 1893 we noted a great discrepancy in the size of the ascospores between our specimens and those from Europe, and on the label of our New York Fungi Exs. 360 we called attention to the fact that the spores in our plant were  $24-32 \times 10-13 \mu$  instead of  $15-22 \times 6-8 \mu$  as given for the European plant. We have since examined many herbarium specimens from different parts of the United States and have as yet found but two specimens from east of the Pacific Coast which agree with *R. aquila* of Europe. They are both in the Mycological Collections of the Bureau of Plant Industry from Temple, Texas, collected by B. F. Dana 1929 and C. H. Rogers 1934. All other specimens labeled *R. aquila* thus far examined are *Rosellinia corticium* (Schw.) Sacc. or some other species. There are, however, two packets of *R. aquila*, apparently parts of the same specimen, in Mycological Collections from the George W. Clinton Herbarium of Buffalo, N. Y., but their place of collection is considered doubtful. They may be of European origin. The synonymy is as follows:

ROSELLINIA AQUILA (Fries) DeNot. Giorn. Bot. Ital. 1: 334. 1884.

*Sphaeria byssiseda* Tode  $\alpha$  and  $\beta$  Fungi Meckl. 2: 10. f. 69, 70. 1791.

*Sphaeria papillosa* Sow. Engl. Fungi 2: pl. 236. 1797. sec. Berk.

*Sphaeria aquila* Fries, Vet. Akad. Hand. 1817: 251. 1817.

*Sphaeria mammosa* With. Bot. Arr. 4: 360. 1830. sec. Berk.

*Hypoxylon aquila* (Fries) Bref. Unters. Gesammt. Myk. 10<sup>2</sup>: 259. 1891.

*Rosellinia byssiseda* (Tode) Schröt. Krypt.-Fl. Schles. 3<sup>2</sup>: 299. 1894.

#### 20. ROSELLINIA CORTICIUM (Schw.) Sacc.

This fungus was described by Schweinitz (Schr. Nat. Ges. Leipzig 44. 1822) under *Sphaeria* as follows:

##### 173. *Corticium* Sz.

*S. simplex maxima*, subiculo filoso-tomentoso orbiculari fusco, sphaerulis subsolitariis, ostiolo nigerrimo impresso.

In ramis Castaneis non infrequens. In subiculo orbiculari e fusco purpurascens plano, 4 lineas lato, corticiformi, e filis intertextis constituto, marginato, nascitur una; alterave interdum conjuncta, magnitudine fere pisi, tomento fusco purpurascens tecta. Ostiolum nigerrimum nudum, acutum.

Fries (Syst. Myc. 2: 442. 1823) treated it as a variety of his *Sphaeria aquila*. Ellis & Everhart (N. Am. Pyren. 164. 1892) also regarded it as a variety of Fries' species. Schweinitz' specimens of this species as found in his herbarium show perithecia and spores much larger than those of *S. aquila*. He separated this species from *aquila* and others by its more or less separate and scattered perithecia and subiculum, but all sorts of intermediate conditions between it and the typical effuse form have been found. Later (Tran. Am. Phil. Soc. 210. 1832) he described as a new species *Sphaeria purpureo-fusca*, as follows:

1499. 354. *S. purpureo-fusco*, L.v.S., ramis querneis increscit passim Bethlehem, tomento crasso purpureo-fusco latissime expanso, peritheciiis primum omnino tectis.

*S. subiculo tomentoso racodioideo purpureo-fusco*, longe lateque effuso, primum perithecia omnino tegente. Subinde obliteratur, peritheciiis caespitosis, aut longitudinaliter seriatis quibus obsitum. Peritheciiis ceterum maximis (imo *Sphaeriae byssisedae* longe majoribus), sparsis ac aggregatis, globosis, undique nisi circa ostiola tomento tenero fusco-purpureo involutis. Ostiolis atris, conicis, nudis, brevibus, interdum quasi lateralibus.

This, according to specimens in Schweinitz' herbarium is simply a form of *S. corticium* with an effuse subiculum. A portion of his

type in the Michener herbarium shows spores  $21-27 \times 8-10 \mu$ , mostly  $21-24 \times 9 \mu$ . A little later as No. 1503 (l.c.) he described as another new species, *S. imposita*, as follows:

1503. 358. *S. imposita*, L.v.S., in dejectis ramulis Bethl. occurrit infrequenter.

*S. subiculo parco longitudinaliter effuso, fusciscenti, imposita sunt perithecia magma, vix immersa, ex atro-fusco, rugulosa, globosa, ostiolo subconico-papillato, sparsim seriat, interdum autem subaggregata, imo subconfluentia. A priori differt indole, magnitudine perithecorum, et subiculo parco.*

Autograph specimens of this species in the Collins Herbarium have perithecia and spores varying but very little from those of his *S. corticium* and *S. purpureo-fusca*. They are from  $22-29 \times 8-11 \mu$ . Parts of the same specimen with the spores the same are also found in Schweinitz' mounted collection and in the Michener Herbarium. Cooke (Grevillea 15: 81. 1887) transferred this species to *Byssosphaeria* as *B. imposita* (Schw.) Cooke and said that the specimen in the herbarium of Berkeley, No. 9601, had lanceolate spores  $25 \times 6 \mu$ . These spores are apparently of quite different shape from those of Schweinitz' type of this species. It is therefore very doubtful whether the specimen Cooke examined was a part of Schweinitz' type material. Saccardo (Syll. Fung. 1: 253. 1882) transferred it to *Rosellinia*.

Besides describing three supposedly new species of *Rosellinia*, as already mentioned, Schweinitz reported *R. aquila*, No. 1497 (l.c.) which he reported as rare at Bethlehem, Pa. He also reported *R. byssiseda*, No. 1500 (l.c.) which he recorded as very common on branches, especially those of *Salix*. He also reported this species earlier from North Carolina. An examination of Schweinitz' specimens of the various species mentioned shows that they are all mere forms or conditions of his *S. corticium*. The specimen he called *S. aquila* is old, most of the subiculum has disappeared and the perithecia are somewhat more crowded than usual. He had, however, mixed with his specimens under this name an old *Hypoxylon rubiginosum*, part of which is in the Michener Herbarium. The specimen he called *S. byssiseda* in the Michener Herbarium, apparently on *Salix*, shows only young perithecia buried in the typical subiculum of *S. corticium*. No spores could be found. As neither Fries nor Schweinitz show any evidence of

having examined or measured the spores of any of their specimens, but only attempted to separate them on the basis of the character and condition of the subcucium and the size and arrangement of the perithecia, characters which have been demonstrated to be variable and to have no specific value, it is not surprising that they should have confused various forms and treated them as separate species. Wherever we have found ascospores in any of Schweinitz' specimens they agree with the measurements of his *S. corticium*.

This species is separated from *R. aquila* (Fries) DeNot. by its larger perithecia and ascospores, which vary from  $18-32 \times 7-12 \mu$ , averaging about  $24-26 \times 8-9 \mu$ . In *R. aquila* the spores vary from  $14-23 \times 6-8 \mu$ , mostly  $16-18 \times 6-7 \mu$ . There is also a difference in the conidia. Those of *R. corticium* are  $3-6 \times 2-4 \mu$ . In *R. aquila* (sec. Brefeld) they are  $8-10 \times 3-4 \mu$ .

Specimens have been examined from many of the States from New England to Washington and south to Florida, Texas and California. Typical specimens from S. C. Teng, Yen-Tsin, Yun-nan (No. 1033) and Jien-mu-shan, Chekiang (No. 1089), China, are in the Mycological Collections of the Bureau of Plant Industry. The synonymy is as follows:

- ROSELLINIA CORTICIUM (Schw.) Sacc. Syll. Fung. 1: 253. 1882.  
*Sphaeria byssiseda* Schw. Schr. Nat. Ges. Leipzig 1: 43. 1822.  
 Non Tode.  
*Sphaeria aquila* Schw. Trans. Am. Phil. Soc. II. 4: 210. 1832.  
 Non Fr.  
*Sphaeria aquila*  $\beta$  *corticium* Fries, Syst. Myc. 2: 442. 1823.  
*Sphaeria purpureo-fusca* Schw. Trans. Am. Phil. Soc. II. 4: 210. 1832.  
*Sphaeria imposita* Schw. Trans. Am. Phil. Soc. II. 4: 210. 1832.  
*Rosellinia aquila* Am. auct. Non DeNot.  
*Byssosphaeria imposita* (Schw.) Cooke, Grevillea 15: 122. 1887.  
*Byssosphaeria corticium* (Schw.) Cooke, Grevillea 15: 122. 1887.  
*Byssosphaeria purpureo-fusca* (Schw.) Cooke, Grevillea 15: 122. 1887.  
*Rosellinia imposita* (Schw.) Sacc. Syll. Fung. 9: 496. 1891.

21. SPHAERIA AFFLATA Schw. Schr. Nat. Ges. Leipzig  
1: 34. 1822.

Schweinitz' original description was as follows:

68. *afflata* Sz.

*S. monosticha tenuissima effusa effigurata nigerrima; ostiolis minutissimis dense punctata.*

In lignis siccis.—Tenuissima, effiguratas maculas variae figurae quasi graphicas exhibens, ligno quasi afflata uti mappa geographica effigurata, lignum nullo modo penetrans. Sphaerulae confertissimae minimae in stromate quasi nidulantes.

About the same time Fries (Syst. Myc. 2: 344. 1823) published the following description based upon specimens of Schweinitz' original gathering from North Carolina:

50. *S. afflata*, effusa, tenuissima, effigurata, nigerrima, peritheciis confertissimis minimis prominulis dense punctata.

*S. afflata*. Schwein! l.c. n. 68.

Omnium hujus seriei tenuissima, maculas atramentosas opacas variae figurae & saepius lobatas exhibens, ligno quasi afflata (nullo modo immersa), uti mappa geographica effigurata. Perithecia minima, superficialia, stipatissima, plane concreta stroma sistunt. In lignis siccis Carolinae. (v.s.)

Later Schweinitz (Trans. Am. Phil. Soc. II. 4: 192. 1832) mentions the species as follows:

1203. 57. *S. afflata*, L.v.S., Syn. Car. 68, F. 50, etiam Bethl.

Schweinitz' original packet labelled "*Sphaeria afflata* LvS Fr. Sal. & Bethl." is empty. There is a bit of it in the Collins collection of Schweinitz' specimens bearing the same label. This contains two pieces of thick, dead bark looking exactly alike. There is also an autographed specimen from Schweinitz in Brongniart's Herbarium in the Paris Museum labelled, "*Car. Sup. Schw. 1824*," on the same kind of bark, and identical in appearance with the others. There is also a specimen in Schweinitz' mounted collection at Philadelphia which is identical in appearance. The part of Schweinitz' specimen in the Michener Herbarium consists of a piece of dead bark with the remains of a gummed paper strip, and is probably part of the Salem specimen. This is exactly like all the others examined except in size and outline of the stromata. A thorough microscopic examination of these specimens shows no spores of any kind. The macroscopic appearance of the specimens

is that of a very thin layer of closely packed minute perithecia resembling somewhat *Diatrype stigma* (Hoffm.) DeNot. The specific name evidently refers to the very thin superficial stroma.

We have been on the lookout for specimens of this fungus for many years, but have never seen anything exactly like it until very recently. While examining specimens of *Nummularia* in the Lloyd herbarium, we found two gatherings labelled "*Nummularia* sp.," which in general appearance look exactly like the Schweinitzian specimens we have examined. The only references to this species since Schweinitz' record that we have been able to find are as follows: Curtis (Catalogue of Flora of North Carolina 140. 1867) lists it as *Hypoxyylon afflatum* (Schw.). Saccardo (Syll. Fung. 1: 391. 1882) also refers it to *Hypoxyylon*, but with no additional information. Cooke (Grevillea 11: 128. 1883) has the following note: "1502 *Hypoxyylon afflatum* Schw. allied to *Diatrype stigma* with hyaline sporidia." We do not know the source of the specimen in which Cooke found "hyaline sporidia." Saccardo (Syll. Fung. 9: 477. 1891) on the basis of Cooke's note just mentioned records the species as *Diatrype afflata* (Schw.) Cooke. Ellis and Everhart (N. Am. Pyren. 743. 1892) say "the specimen in Herb. Schweinitz is a mere sterile crust." This species is not mentioned by Starbäck in his account of Schweinitz' species found in Fries' Herbarium.

The two specimens discovered in the Lloyd herbarium labeled *Nummularia* were collected by C. H. Demetrio near Emma, Mo. Demetrio No. 820 (13059 Lloyd Herb. Cat. No.) on hickory bark, Nov. 1921, agrees entirely with Schweinitz' original specimens, but instead of being sterile shows pycnospores or spermatia. The spores fill the pycnidia in a hyaline gelatinous mass, and are very minute, subelliptical, about  $1.5 \times 1 \mu$ . The other specimen is Demetrio No. 817 (13049 Lloyd Herb. Cat. No.) on bark of dead oak, Jan. 17, 1923. This specimen fortunately shows good perithecia with mature asci and ascospores, which agree most nearly with the genus *Melanomma* as typified by *M. pulvis-pyrius* (Pers.) Fuckel. As we have found no fungus agreeing with this described under this or other related genera, we designate the species ***Melanomma afflatum*** (Schw.) Shear, comb. nov., with the following description:

Stromata very thin, effuse, irregular in outline,  $\frac{1}{4}$  to  $\frac{1}{2}$  mm. thick; perithecia small, very densely arranged, carbonaceous, globose; ostioles small, slightly prominent becoming umbilicate; asci elongate-clavate, subsessile,  $65-75 \times 12-16 \mu$ ; ascospores sub-biseriate, oblong elliptical, somewhat inequilateral, 3-septate, somewhat constricted at the middle, upper half somewhat larger, dark brown,  $15-18 \times 8-9 \mu$ ; paraphyses filiform, entangled or anastomosing, exceeding the asci.

Habitat. Surface of smooth, dead, old oak and hickory bark.

## 22. DOTHIDEOVALSA TURNERAE (Tassi) Shear

This name proposed in the author's Mycological Notes III (Mycologia 31: 336. 1939) should be changed to **Dothideovalsa eutypoides** (Ellis & Ev.) comb. nov. inasmuch as the specific name *eutypoides* has priority over *turnerae* (1899), it having been published as *Bagnisiella eutypoides* Ellis & Ev. Jour. Inst. Jamaica 1: 382. 1893. This citation is not included in Farlow's list of the works of J. B. Ellis and hence was overlooked, the name having been regarded as an herbarium name only.

BUREAU OF PLANT INDUSTRY,  
WASHINGTON, D. C.

## NOTES AND BRIEF ARTICLES

### BOLETUS BREVIPES PECK IN SOUTHERN CALIFORNIA

This fungus has been collected in abundance in a planting of pines at the Citrus Experiment Station. *Boletus brevipes* is not listed by McClatchie in Seedless Plants of Southern California. Dr. Lee Bonar, of the University of California, reports in a personal letter that this species has been collected only a few times in the mountainous area of California. Its development has doubtless been favored by the continuous and (for southern California) heavy rains of the month of February, 4.65 inches distributed in Riverside on 12 different days.—CLAYTON O. SMITH.

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### PYRENOAMYCETE NOTE

#### 1. *Mycosphaerella nigrita* (Cooke) Miller, comb. nov.

*Sphaerella nigrita* Cooke, Grevillea 7: 13. 1878.

The perithecia are congested in orbicular spots, semi-erumpent, with elongate elliptic, uniseptate, hyaline ascospores,  $15 \times 4 \mu$ .

On oak leaves in New York, sent to Cooke by Gerard. This species also occurs in Georgia on *Quercus lyrata* Walt.

There are two other species on oak leaves in Georgia. *Mycosphaerella spleniata* (Cooke & Peck) House occupies large areas on the leaf and the perithecia are also congested, but differs macroscopically in possessing smaller perithecia almost completely sunken in the leaf. Then *Mycosphaerella maculiformis* (Pers. ex Fries) Schroet. differs in occurring in very small, angular spots only a few millimeters in diameter, and apparently never spreads out over large areas of the leaf as the other two species.

There is a later *Sphaerella nigrita* Roum. in Fungi Gall. no. 1606, 1879-1898. This name would have no validity because of the date and also because of the lack of a formal published description.—JULIAN H. MILLER.

## MYCOLOGICAL SOCIETY OF AMERICA

## SUMMER FORAY

The 1941 Foray will be held at Macdonald College, August 25-28 inclusive, with the Department of Plant Pathology at Macdonald College and the Department of Botany at McGill University as hosts. Headquarters will be in the Department of Plant Pathology in the Biology building.

Macdonald College is located in the town of Ste. Anne de Bellevue on the western tip of Montreal Island at the confluence of the Ottawa and St. Lawrence Rivers some 20 miles west of Montreal.

Those coming eastward from Toronto or Ottawa will cross two large bridges over the Ottawa River (the second a toll bridge) into the town of Ste. Anne de Bellevue. Macdonald College is about  $\frac{1}{2}$  mile east. Both Route 2 and the new 4-lane highway, as yet unnumbered, pass through the College, which can be recognized by its brick buildings with red tile roofs.

Those approaching from the south and east should come via Montreal. Cross a toll bridge over the St. Lawrence River, turn westward and follow the Toronto-Ottawa highway, Route 2, or the new 4-lane highway for about 20 miles. Do not cross a second toll bridge.

Accommodations will be furnished in the dormitories and dining room of the College at the rate of \$2.50 a day a person, 2 in a room, or \$4.00 a day a person, single room. Those who plan to take advantage of the College facilities should notify Dr. Ivan H. Crowell by August 20th, if possible—post office address Macdonald College, Quebec; telegraph address, Ste. Anne de Bellevue, Quebec.

The general terrain of Macdonald College is largely flat hardwood and farm land, entirely different from the hilly coniferous forests found at Duchesnay where the 1938 Foray was held. From the College one can see the low foothills of the Laurentian Mountains which contain mixed hardwoods and conifers. A little farther north are pure coniferous stands with numerous ponds and swamps. Trips to some of these Laurentian areas will be planned for the Foray.

For the entertainment of wives, children and friends, golf, tennis, swimming, boating, picnicking, hiking and library facilities will be available, not to mention shopping and sight-seeing trips to near-by Montreal.—WALTER H. SNELL, VICE PRESIDENT.

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A TWEEZERS METHOD FOR MAKING MICROSCOPIC SECTIONS OF  
PLANT PATHOLOGICAL MATERIAL <sup>1</sup>

(WITH 6 FIGURES)

The type of tweezers found to be most satisfactory for the purpose of making microscopic sections was a small pair about 3" long with either straight or curved ends such as is generally used in laboratories. It is essential that the tips of these tweezers be of the same length and sharpened to a knife-like edge as shown in the line drawing. This can readily be done with the aid of a small hone. The advantages in having the tweezers sharpened in this manner is that their tips meet with exactness and they can do some cutting (FIG. 6).

The basic technique of the method is that of stripping plant tissues. The procedure has long been followed, as for example, in stripping the epidermis for the purpose of studying stomata, or examining teliospores of certain rusts which form in epidermal cells. The writer wishes to call attention to certain other possibilities. Interesting mounts of several species of parasitic Phycomycetes have been prepared by the stripping method. By cutting through the infected epidermis with the tweezers, gently stripping a portion off and mounting it with a minimum of disturbance in such media as lacto-phenol or glycerine jelly, mounts may be obtained similar to the one shown in figure 1. In such mounts conidiophores can be seen protruding through stomata, in various stages of development and with some spores still attached.

Quite a different type of mount is shown in figures 2 and 3. Fine hair-like strands are readily stripped longitudinally from

<sup>1</sup> Contribution from the Faculty of Agriculture, McGill University, Macdonald College, Que. Macdonald College Journal Series No. 152.

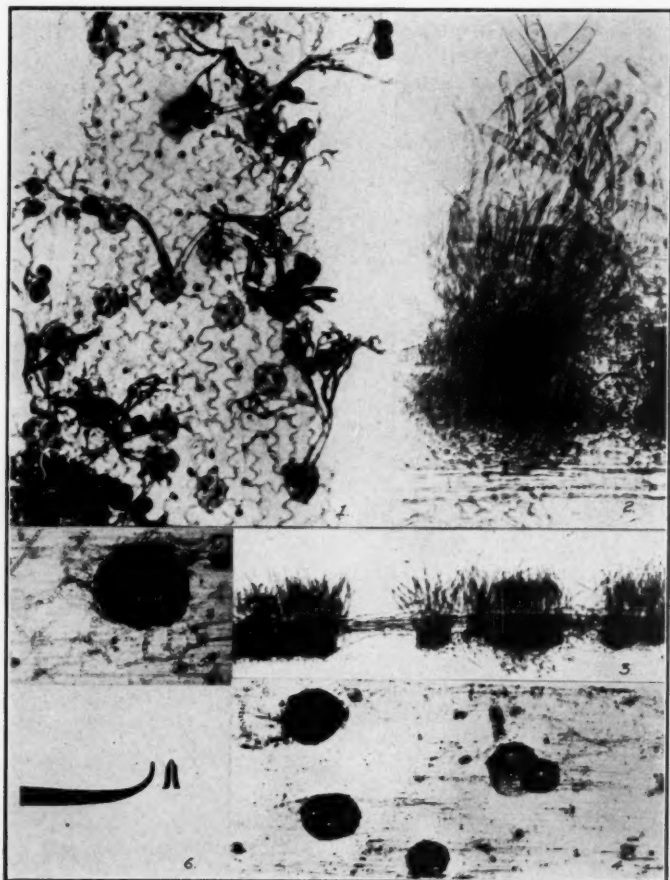


FIG. 1. Fruiting structures of *Peronospora corydalis* are shown in various stages of maturity protruding through stomata on a leaf of *Dicentra cucullaria*; 2, an enlarged fruiting stroma of *Scolecotrichum graminis*; 3, several fruiting stomata of *S. graminis* are shown in relation to the host tissue; 4, *Phoma herbarum*, a general view of pycnidia and mycelium on the epidermis of a petiole of rhubarb; 5, an enlarged pycnidium and some of its supporting mycelium; 6, tweezers to be used for making microscopic sections should be sharpened as shown.

leaves of grasses or other monocotyledonous plants. The plane of stripping is at right angles to the surface. The section illustrated shows in original relationship the completely submerged stromata with conidiophores and several conidia attached. Similar mounts have been prepared showing conidiophores emerging singly or in small non-stromatic groups, often with much detail of the internal mycelium from which they arose.

In figure 4 is shown a similarly made preparation of an imperfect fungus in which the pycnidia and mycelium are mounted whole and in their original relationship with the host epidermis. Greater details are shown of a single pycnidium and part of its mycelium in figure 5.—IVAN H. CROWELL.<sup>2</sup>

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#### REPRINTS AND BOOKS FOR CHINA

I have been asked by the West China Institute of Applied Biology, West China Union University and the Division of Mycology and Plant Pathology, Chinese National Tea Station, National Bureau of Agricultural Research to collect reprints of articles and books pertaining to phytopathology and mycology.

These institutions have never had an adequate number of periodicals and books in these fields. Now, because of the conditions brought on by the war, they have lost some of the material formerly possessed.

I earnestly hope that mycologists and phytopathologists in America who have such reprints of articles or books will be so kind as to contribute to these institutions. It will be of extreme value to the Chinese educational program as well as the advancement of biological sciences and the faculty of these institutions will be everlastingly grateful to you.

These materials may be sent directly to me and I will see that they get into China. Be assured they will be most gratefully received.—WEN-CHUN Ho, Department of Botany, Iowa State College, Ames, Iowa.

<sup>2</sup> Lecturer in Plant Pathology, Macdonald College, Que.

REVISED DESCRIPTIONS OF THE GENERA *ELSINOË* AND  
*SPHACELOMA*

In connection with a monograph on *Elsinoë* and *Sphaceloma* it has seemed desirable to present beforehand revised descriptions of these myriangiaceous genera:

*ELSINOË* Racib. Emend. Par. Algen Pilze Java's 1: 14. 1900.

*Plectodiscella* Woronichin, Myc. Centralb. 4: 232. 1914.

*Isotexis* H. Sydow, Ann. Myc. 29: 261. 1931.

Fertile stromata embedded in the host tissues, scant or effuse, consisting of more or less well defined masses of tissue or composed of hyaline or pale yellowish pseudoparenchymata, changing internally into a more or less loose prosenchyma and thus gradually intermingling with the diseased host tissue, sometimes confined to outer portion of host tissues, frequently originating in or just below the disrupted epidermis and becoming erumpent and well defined only on the exterior portion, there often covered with a dark layer, sometimes referred to as the epithecium, of variable thickness, occasionally linear and branched, following the leaf veins; asci few to numerous, irregularly imbedded in the stroma, and where stroma is scanty, apparently developed almost directly in host tissues, globose to piriform, double-walled, with outer wall thin and inelastic and inner wall thickened especially at the apical region and provided with a more or less well developed foveola, expanding upon rupture of outer wall, containing 1 to usually 8 spores; ascospores hyaline, typically 3 septate, more rarely 4-5 septate, sometimes with a longitudinal or diagonal septum in one or more cells, the two upper cells often broader and shorter than the lower ones, usually germinating by sprout conidia, but may produce germ tubes, one from each cell.

Conidial stage, *Sphaceloma*.

Type species, *Elsinoë Canavaliae* Racib., causing scab of *Canavalia gladiata* (Jacq.) DC.

Strictly pathogenic, producing destructive anthracnoses of plants of many families, from the Pteridophyta to the Compositae, lesions small, necrotic or hyperplastic, often numerous or coalesced, and on leaves attacking veins and petioles as well as non-vascular areas; gumming of tissues occurring beneath host cells first invaded, which become killed and desiccated; in hyperplastic lesions, on leaves as well as other parts, a definite generating layer being formed, which

gives rise to the hyperplastic tissue forming the excrescences often called scabs, *e.g.*, those of scab of sour orange caused by *Elsinoë Fawcetti*.

*SPHACELOMA* DeBary, Emend. Ann. Oenol. 4: 165-167. 1874.

*Manginia* Vial. & Pacot.<sup>1</sup> Compt. Rend. Acad. Sci. Paris 139: 88. 1904.

*Melanobasidium* Maubl. (*Melanobasis* of Clements & Shear, Genera of fungi 370. 1931.) Bull. Soc. Myc. Fr. 22: 64. 1906.

Hyphae subcuticular or more often intraepidermal, composed of strands of more or less well developed hyaline or yellowish pseudoparenchyma, supporting clusters of densely crowded, short conidiophores, often assembled in conical, protruding bundles, or forming a continuous superficial layer or palisade, but sometimes depressed into a typical acervulus, the pseudoparenchyma and overlying conidial layer also sometimes constituting sporodochial masses, hyaline at the base, generally darkening towards the outer surface, scattered or coalescing into a continuous pseudoparenchymatic stroma, bearing on the surface a layer of usually dark closely appressed cells, the palisade of conidiophores; conidiophores usually short, cylindrical, pointed at apex, or broad at base, narrowing to a point, often unicellular or 1-septate, more or less the length of the conidia, occasionally longer, practically flexuous, several septate, at times branched and geniculate at the insertion of conidia, forming bundles or a uniform covering of velvety appearance over the lesion; producing conidia acrogenously or pleurogenously, from one to several in succession from the same point sometimes shortly catenulate; conidia hyaline, continuous, small, refringent, ovoid to oblong-elliptical, often having at either end a shining guttula, with mucilaginous wall, occasionally elongate to cylindrical, with one to several septa, yellowish or dark; minute refringent, bacterium-like bodies, with a thick gelatinous wall, provisionally called microconidia, also formed. Pycnidia or pycnidia-like bodies sometimes formed, *e.g.*, in *Elsinoë Rondii*; microconidia more or less constantly in evidence, sometimes filling

<sup>1</sup> These authors substituted the name *Manginia* for *Sphaceloma* upon obtaining, in what they supposed were pure cultures of *S. ampelinum* DeBary, forms which they describe as spermagonial, pycnidial, yeast, etc. From their account of these cultures it is apparent that they were in part if not entirely impure. The name *Manginia*, therefore, refers only in part to the genus *Sphaceloma*.

host cells; conidial fructifications sometimes indistinct or practically lacking or conidiophores present and conidia not in evidence, these being produced promptly, however, under favorable conditions and germinating by sprout conidia or by germ tubes, sometimes becoming greatly swollen and muriform, young as well as old hyphae capable of conidial production. *Sphaceloma* as well as *Elsinoë*, producing a slow compact, often colorful, gummy growth on most agar media.

Type species, *Sphaceloma ampelinum*, causing anthracnose of grape (*Vitis*). Ann. Oenol. 4: 165-167. 1874.

Hosts, as for the genus *Elsinoë*.—A. E. JENKINS AND A. A. BITANCOURT.

